ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXIV. No. 43.

TABLE OF CONTENTS.

Engineering News of the Week 363
Technical Articles:
The Kunstadter Steering Screw (*illustrated*) 364
The Present and Proposed Tidal Drains of Charleston, S. C. 364
The Transandine Railway (*illustrated*) 365
Timber Supply vs. Railroad Consumption 365
The New Lake Michigan Intake of the Milwaukee Water-Works (*illustrated*) 366
The Visp-Zermatt Abt Railway 367
Municipal Engineering in Liverpool (*illustrated, continued from page 291*) 368
The Northern Pacific Railway's Annual Report 369
The Price of Asphalt 370
The Proposed Birmingham and Liverpool Ship Canal 370
The International Engineering Convention (*continued*) 370
Legal Decisions of Interest to Engineers 371
The Government Engineers of France 377
Rail Sections for Electric Railways (*illustrated*) 378
Thomas Slag Fertilizer 378
The Lake Superior Copper Mines 378
Friction Drum Power Hoist (*illustrated*) 379
The Sodom Dam (*illustrated*) 379
The World's Telegraph Lines 379
Adopted Sections of Storm Sewers for Duluth, Minn. (*with inset*) 380
Electrical Pranks 380
An International Cable System 380
Crude Oil vs. Coal 380
Employers' Liability and Accident Insurance 380
Graphic Diagram of Air Compression—Correction 380
History of English Weights and Measures 381
Personals, New Publications, Society Proceedings 371–376
Editorial Notes 374
Electricity as a Motor—A Congress of Engineers—Brake Practice in England—The Survey of Alaska.
Editorials:
The Channel Tunnel 374
Notes from Abroad (*Editorial Correspondence*) 375
Correspondence 376
The Red Rock Cantilever Bridge (Correction)—San Diego Sewerage—142,857—Watches as Compasses—An Early Ice-Breaking Steamer (*illustrated*)—Notes and Queries.
Construction News 381–384
Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

RAILWAY EARNINGS for the month of August, and for the first eight months of 1890, according to statistics collected by the *Financial Chronicle*, are as follows:

	August. (125 roads.)		Jan. 1 to Aug. 31. (115 roads.)	
	1890.	1889.	1890.	1889.
Gross earn.	$58,743,102	$57,477,526	$338,132,686	$303,967,093
Oper. exp..	37,904,138	35,454,306	272,955,130	246,150,409
Net earn..	$20,838,964	$22,045,220	$125,177,556	$117,816,684

THE PIKE'S PEAK RACK RAILWAY is practically completed, and on Sunday, Oct. 19, the first engine reached the top of the peak, 14,200 ft. above sea level. This is almost the highest altitude yet reached by a locomotive, being only exceeded by the Lima & Oraya lines over the Andes with a maximum elevation of 15,670 ft. above sea-level.

AN AIR-BRAKE CONNECTION between the cars, invented by M. LEGAT, a French civil engineer, has lately been adopted on the Paris, Lyons & Mediterranean and the Eastern railways of France. It is an ingenious combination of thin metal discs so joined as to form an accordion-like tube of extreme flexibility. It will resist a pressure of 350 lbs. per sq. inch, and has stood two years of exhaustive trial. It is claimed as being superior to gutta-percha in resisting internal and external influences and consequent loss of elasticity.

A VESTIBULE DEVICE has been patented by Manager T. A. BISSELL, of the Wagner car shops, to obviate the claims of Mr. GEORGE M. PULLMAN. Instead of the Pullman face-plate, a heavy molded casing is used, and the vestibuling is effected by means of automatic spring curtains, made of varnished duck outside and black corduroy inside. These curtains are stiffened by perpendicular steel rods and transverse strips of stout rubber, the latter serving as springs to keep them in compact folds when uncoupled. Each side of each platform has its curtain, with the rear edge permanently fixed to the car. Overhead is a secondary curtain, under a hard rubber shield, fast on one side, and held up, when in use, by rods sliding in a tube and by a set of hooks running from the opposite side. The release of a trip-lever frees the heads of the hooks, and the curtains are released. The arrangement is said to be quickly and easily operated.

THE TRAIN-STAFF SYSTEM has been adopted on the Central New England & Western R. R. for moving trains between Maybrook and Campbell Hall. This system is already in use on the Shore Line in New York State, and is similar to the well-known English train-staff system,

THE BONZANO METALLIC TIE CO., lately incorporated with a capital of $1,000,000, is to establish a large plant near Philadelphia for manufacture. This tie is patented by Mr. M. F. BONZANO, Assistant Gen. Superintendent of the Reading R. R. There are two sizes of the tie, one weighing 140 lbs., made of steel ⅝ in. thick, while a smaller size weighs 105 lbs., the steel being but ½ in. thick. They are 8 ft. long, 8 ins. wide across the top and 3½ ins. high. The hollow underneath is filled in with a ballast of broken stone and dirt. The heavy ties cost $2.25 and the light ones $1.65. They are made of Bessemer rolled steel, and are laid 2½ ft. apart from center to center.

THE WORST ACCIDENT OF THE WEEK was one of three almost simultaneous ones in different parts of the country, all collisions due to imperfect handling of trains immediately after some disturbance due to prior accidents. On the Cincinnati Southern two southbound passenger trains scheduled an hour apart were held at Somerset, Ky., Oct. 22, by a freight wreck. A northbound freight train had to pass them both after traffic was resumed, and passed the first in safety; but "the crew overlooked the fact' that another train was following close behind, and a quarter of a mile from where they pulled out, collided with it in a tunnel; fortunately, so far through it that only half the train was within it; 6 trainmen where killed outright, and 3 trainmen and 4 passengers injured; 4 passenger cars were burned within the tunnel.——At Ensley City on the Kansas City, Memphis & Birmingham road, a precisely similar case of carelessness (*i. e.*, human weakness, which cannot be eradicated from human nature) led an engineer to pull out, after an hour's delay waiting for a connection, without waiting for his conductor and the attachment of a sleeper. He had run 2 miles before he discovered his error, then started back "without hesitation" and collided with a freight, costing the lives of 2 and bad injuries to 12.——On the Union Pacific near Kansas City, a train stopped to avoid running into a disabled train ahead and was run into by a train behind "before a flagman could be sent back" causing 1 death and 7 bad injuries.

A BRIDGE FELL on the Boulder Branch of the Northern Pacific Railroad, under a freight train, which dropped 70 ft. into the gorge below, injuring 7 persons. The bridge was probably a small Howe truss, but may have been a trestle. Two similar "bridges" or trestles were washed out in a heavy storm on the Pittsburg Division of the Baltimore & Ohio R. R.

THE IRISH CHANNEL TUNNEL PROJECT is being again revived, and at a public meeting held in London, on Oct. 18, Engineer BARTON submitted a plan for a tunnel costing about $30,000,000. It could be finished in 12 years, and a committee, headed by the Duke of Abercorn, is to bring the matter before the English Government.

THE BERTHOUD PASS CANAL CO. is a Colorado corporation recently formed for the purpose of bringing water to Colorado, for irrigation purposes, from the Pacific slope of the "Great Divide." This scheme includes the tunneling of the Rocky Mountains, near Berthoud Pass, on the boundary of Grand and Clear Creek counties. Mr. G. H. CLARK, who is largely interested in irrigation enterprises, and is at the head of this project, proposes a tunnel 1¼ miles long and about 200 sq. ft. water area—one that would irrigate the land 50 miles east of the Pass. Water is plentiful on the west side of the Pass and it is now practically wasted. According to the Denver *Times*, a company is already formed, and complete surveys are in progress under Mr. EDWARD L. ROGERS, Civil Engineer.

THE OKEFINOKEE SWAMP IMPROVEMENT CO. is preparing to go to work on this Georgia improvement, whereby 300,000 acres of land are to be reclaimed. Col. S. B. CARTER, the Chief Engineer of the company, is now sounding along the line of the drainage canals. A main canal 7 miles long will empty the swamp water into the St. Mary's River; and to this main canal many laterals will lead.

THE DIAMOND SHOAL LIGHTHOUSE, off Cape Hatteras, lately let to Messrs. Anderson & Barr, has progressed sufficiently for a call for bids for 215 tons of mild steel, to be used in the lower 30 ft. of the caissons. Address 240 Eleventh St., Jersey City, N. J.

THE METRIC SYSTEM is to be officially adopted by the Mexican Republic as the exclusive standard of weights and measures.

THE CENTRAL & SOUTH AMERICAN CABLE CO. shipped, on Oct. 13, 1,758 miles of its submarine cable to Valparaiso. This cable will be laid between Chorrillos, Peru, and Valparaiso, Chili, connecting with the American line, via Galveston.

ENGLISH CHANNEL TRAFFIC, for the quarter year just closed, shows the passage of 181,250 persons traveling by the Dover-Calais, Folkestone-Boulogne and Newhaven-Dieppe routes. In the corresponding quarter of 1889 the number was 294,548. The Dover-Calais route carries 50% of the total, and the Newhaven-Dieppe, 27.3%.

ENGLISH MINING STATISTICS, as given in the report of the inspectors of mines for 1889, show 489,179 people employed underground; 117,976 above ground and about the mines; output of coal, 176,916,724 tons as compared with 169,935,219 tons in 1888. The output of iron ore in 1889 was 8,270,542 tons, against 8,635,032 tons in 1888, and an average of 10,906,233 tons for the 15 years of 1873-87. During 1875-77 inclusive, the output was about 12,000,000 tons per annum. The accident list includes 848 accidents and 1,048 persons killed in 1889. The ratio of fatal accidents to persons employed was one for every 665 persons, against one to every 652 persons employed in 1888; one to 634 in 1887, and one to 644 in 1886.

THE TOWN REFUSE DESTROYER, at Leeds, England, deals with 70 tons of refuse daily, including in this dead pigs, dogs, etc. The furnaces are fed by the fuel in the refuse, and steam produced by this operates an engine and mortar mills which convert the cinder and slag into mortar. One part of lime is added to three of ground clinker, and the product sells readily for $1.25 per ton and nearly pays the cost of the works. Four men, two in the day and two at night, operate the works and these are each paid $7.50 per week. The refuse destroyer recently built at Hastings and costing about $20,000, has proved a success in its 10 months operation, and has already saved much money. It was recently inspected by the representatives of sixteen corporations and eight of these have decided to adopt it.

THE WESTERN PART OF MONTANA, according to a correspondent, "is a splendid country, and the new branches that the Northern Pacific has recently built open up a great mining, agricultural, and timber country. I never saw a country anywhere that has such an excellent water supply, and the farmers are taking advantage of it. Also, lots of money is being made every day in mines. The climate is fine, and the scenery is grand."

STETTIN CEMENT, according to the report of U. S. Consul A. F. FAY, is made by six separate works in the neighborhood of Stettin. The total output of these six companies is about 1,000,000 barrels per annum of 375 lbs. per barrel. About 750,000 barrels are sold for domestic use. The cost of manufacture, including labor, is about 23 cts. per 100 lbs. The raw materials consist of 90% chalk and about 10% of argillaceous earth, or fatty blue clay. This mixture is allowed to slack for a few days, then dried, burned and pulverized. The companies are said to be in a prosperous condition, and the Stettin Portland Cement Co. had just declared a dividend of 27% on the amount invested.

THE FORESTS OF AMERICA cover but 11% of its entire area, while Germany has 26% of woods, said Chief Forest Master KESSLER at the Berlin meeting of the German Geographical Society.

The Kunstadter Steering Screw.

The accompanying cut represents the Kunstadter steering screw, as applied to the fire boat *New Yorker*, designed for use in New York Harbor. The principal dimensions of this vessel are: Length over all, 125 ft. 5 ins.; length on load line, 115 ft.; greatest beam, 26 ft. 11 ins.; beam on load line, 25 ft. 2 ins.; extreme draught, 10 ft.; displacement, 351 tons. The vessel will be tested shortly, and the results of the trial will be of much interest not only on account of the steering screw apparatus, but also from the size of the steamer, which considerably exceeds that of all previous fire-boats and tugs.

A large number of experiments were made with this apparatus several years ago by a special board of U. S. Naval Engineers. They reported that the Kunstadter apparatus decreased the diameter of the circle in which the vessel could be turned, in a ratio varying from 1 to 1.031 at a rudder angle of 10° up to 1 to 1.764 at a rudder angle of 45°. The experiments were conducted with great care; when the plain rudder was used its area was increased by an amount equal to the projected area of the screw, the hull was kept in perfect condition, the same amount of coal was taken on board each morning and all precautions taken to have the conditions remain uniform.

The results of these trials have been summed up by B. F. ISHERWOOD, late Engineer in Chief, U. S. Navy, as follows:

The conditions of the competitive trials, for reasons beyond the control of the Board, were more favorable to the rudder alone, relatively to the Kunstader apparatus, than should have been the case. With conditions entirely proper for both, the Kunstadter apparatus would have given still higher comparative results.

The *Nina*, the vessel used in the tests, is a screw steamer of 137 ft. length on the water line, 26 ft. 1 in. breadth on the same, and 343⅝ tons displacement at the experimental draught of water. She is propelled by a single cylinder engine of 35 ins. diameter of cylinder, and 30 ins. stroke of piston, driving, when the rudder was used alone, a 4-bladed screw propeller of 10 ft. diameter, 15 ft. pitch, and 42.4178 sq. ft. of projected surface on a plane at right angles to the axis.

When the Kunstadter system was applied, there was used additionally to the above described screw a small swiveling or steering screw of 6 ft. 8 ins. diameter, 15½ ft. pitch, and 11.7616 sq. ft. of projected surface on a plane at right angles to the axis.

The two screws in the Kunstadter system are connected by a universal joint of peculiar construction, combining mechanical elegance, convenience and efficiency in the highest degree, whereby the small or after screw can be swiveled or turned in any direction, either to starboard or port, up to the angle of 45° in the *Nina*. For the rudder alone this is the angle which gives the maximum steering results, and nothing can be gained by increasing it; on the contrary there is a loss. But the swiveling screw can be used practically up to the angle of 55° and with increased efficiency; in fact, its efficiency as a steering instrument would increase up to 90° were it possible to be worked at that angle.

With the two steering systems as described, the following are the turning results obtained at the maximum for both, the vessel in each case making the speed of 2¼ geographical miles per hour on the circumference of the turning circle. As the diameters of the turning circles are greatly affected by this speed of vessel, becoming greater as this speed is greater and *vice versa*, correct comparison requires equal experimental speeds of vessel on the circle with each steering system.

With the rudder alone in use, and at the angle of 45°—the position in which it gives the maximum steering effect—the diameter of the turning circle was 520.5 ft. As the length of the vessel on the water-line was 137 ft., the diameter of the circle was 3.8 times the vessel's length This proportion gives an uncommonly small circle for a vessel to turn in by her rudder alone, and is due to the excessive dimensions of the latter relatively to the former.

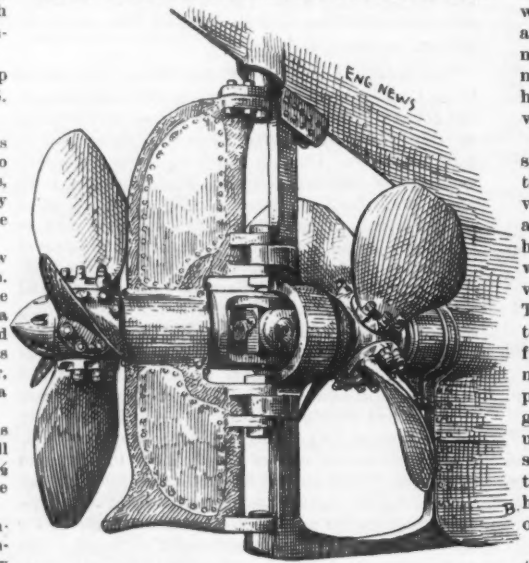
With the Kunstadter apparatus in use, the rudder and the axis of the steering screw being at the angle of 45°, the diameter of the turning circle was 314.2 ft. The length of the vessel on the water-line being 137 ft., the diameter of the circle was only 2.29 times the vessel's length.

The diameter of the turning circle with the rudder alone was 65⅝% greater than with the Kunstadter apparatus. Or the diameter of the turning circle with the Kunstadter apparatus was 39⅜% less than with the rudder alone. The time required to make the respective circles was in direct ratio of their diameters.

With the proportions of rudder and screw relatively to size of hull habitually given to sea-going vessels, the Kunstadter apparatus could cause a vessel to make a complete circle on half the diameter required with the rudder alone.

One great advantage of this steering screw is the power of backing, either in a straight line or to either quarter, which the apparatus gives. In the trials of the *Nina* it was impossible to steer the vessel when backing with the plain rudder alone. The vessel was as likely to go to starboard with the rudder to port as in the proper direction. It was impossible to back in a straight line, as is the case with all vessels. With the Kunstadter screw and careful steering the vessel could be steered astern in a straight line, or to either quarter with little difficulty.

The *Stratheden*, a Scotch vessel of 2,000 tons burden, fitted with Kunstadter's screw, sailed 18,400 miles without docking, and at the close of this remarkable series of runs, the universal joint and all accessories were found to be in perfect condition. Mr. KUNSTADTER once demonstrated a great advantage of his apparatus by running this vessel ashore in a mudbank in the Clyde. The steamer was so firmly fixed that it was impossible to pull her off with tugs. When the hawsers had been cast off after the unsuccessful attempt the screws were started and the rudder and auxiliary screw turned slowly from side to side. The wash from the small screw soon scoured away the mud, and the steamer was backed off the bank without outside aid. This



The Kunstadter Steering Screw Applied to the Fireboat "New Yorker."

experiment has been repeated with the Cleveland, O., fire-boat, also furnished with the steering screw.

To show the ease with which a vessel using the Kunstadter apparatus can be stopped, we give the following extract from the report of the official trials of the *Stratheden*:

With the vessel going ahead at full speed on a straight course, the engines were suddenly reversed to full speed astern and the helm put hard over, when it was found that the vessel was immediately drawn out of her course by the action of the rudder screw and the way was taken completely off the ship in about 1½ times her length.

This screw has also been applied to sailing vessels and proved of great value. A report on the brig *Goletta*, of 500 tons, states that the action of the vessel was materially improved.

For use on tugs for handling railway car flats, which are especially bad tows, this device would seem to offer many advantages. There is a constant danger of collision with these unwieldy barges in all large harbors, and the Kunstadter steering screw would apparently diminish the chances of a collision and also the time now necessary for transferring cars in this way.

The Present and Proposed Tidal Drains of Charleston, S. C.

Charleston, S. C., is awkwardly situated for purposes of drainage. It lies on a narrow tongue of land, from one-half to three-quarters of a mile wide, between the Cooper and Ashley rivers, and is subject to the influence of a mean tide of 5 ft. rise, with 6.50 ft. spring tide and 9.50 ft. storm tide. The natural height of this tongue of land above mean low tide is from 9 to 20 ft., with a great part of it only 10 to 13 ft. high.

Under these conditions a system of tidal drains were devised and put into operation before the Civil War, by means of which the discharge into the rivers took place at every fall in the tide, and the drainage level was sunk from 10 to 15 ft. below the surface of the ground. As described in a late valuable report of City Engineer LOUIS J. BARBOT to the Mayor of Charleston, Hon. GEORGE D. BRYAN, the proper working of these depended upon the following operations: There were five mouths to this system of drains, and each was provided with a gate. The bottoms of the drains were intended to form a continuous level, 1.66 ft. above mean low tide. At low tide the drains were supposed to be empty and the gates closed. At about one hour before high tide No. 1 gate was opened, and the water rushed in with a head of about 4 ft., and two hours were sufficient to fill the entire system of 5½ miles of drains. One hour after high tide the same gate was again closed, and the water confined until one hour before low tide, when gate No. 2 (or another gate, as circumstances might determine) was opened, and the drains were emptied and scoured out in two hours with the velocity due a 4 ft. head. By this method the scouring out of the drains occurred twice in 24 hours.

Later, this system of manipulation was modified to suit the demands of the fire department, and the water was held in the drains over night to serve as a storage supply in case of fire. By this change in method the flushing was reduced to nine days in the month and the tide water was allowed to enter highly charged with the silted matter of the flood, which was not let out during that period.

Mr. BARBOT says that for some time after construction these drains were in charge of a special tidal-drain keeper, and are said to have worked very satisfactorily. At a later period this office was abolished and their care and custody put into the hands of the city police, and during the war they were left entirely to themselves. As a result they were in places completely filled with sand and silt. The office of tidal-drain keeper has since been established, but the system fails to work with satisfaction, owing mainly to the fact that its management is not in the hands of the city engineering department and effective scouring and flushing is greatly hindered by excessive leakage at the gates, undermining of walls, planking, etc., and the consequent great loss of water. The estimated leakage through gates Nos. 4 and 5 is 20,000 galls. each per hour. The gates themselves are clumsy and their operation tedious and laborious.

Late examinations made by Mr. BARBOT show that there are also considerable changes from the original level of the drain bottoms. At the mouths of the drains the settlement ranges from 6 ins. to 1 ft., and the bottoms of the system of drains shows variations of 3, 6 to 18 ins. in many places, and at some points as much as 2 ft. and even more. These undulations Mr. BARBOT ascribes, first to the scouring action of the tides washing out the sand under the planking, which was originally only intended to receive the brick invert recommended by the old drainage commission and never built; and second, to the late earthquake which may have caused a disturbance of the marl formation underlying the sand stratum in which these drains are built. This latter assumption is not at all improbable, as many fissures in the earth were observed after that serious event. The profile accompanying the report also shows that these irregularities in the bottom also more or less closely follow the surface undulations.

To restore the tidal drains to their original and an improved state of usefulness City Engineer BARBOT makes, in substance, the following recommendations:

(1) A special study and plan of construction for the scouring out of certain sections filled in by tidal action. (2) All the gates to be remodeled so as to be tighter and more easily worked. (3) The readjusting of all planks that underlie the drain walls, and general repair of the system. (4) The bottom of the drains to be reformed at an elevation of 1 ft. above mean low water, and to be made circular or segmental in form, with one course of specially molded hard bricks on edge, laid in cement mortar; the bottom and the sides up to the springing line to be coated with ⅝-in. cement mortar.

Mr. BARBOT also recommends an extension of the system of drains by two leading mains in the Western and Eastern parts of the city, connecting with a system of cross drains made with descending gradients and of studied capacity. To scour out these drains with salt water he proposes to build a reser-

voir by damming up a certain marsh area. This dam, holding over 20,000,000 galls. of water, would also fill the drains at all times for fire protection in the absence of high tides, or a failure of an adequate water supply. Mr. BARBOT believes that this proposed repair and the proper extension of the tidal-drain system is the most economical solution of the vexed drainage question; and that it will be as successful and satisfactory as sewers built on the separate, combined or double systems. It will do away with the great cost of inclined sewers, which can never be built so as to properly drain low lots and cellars, and however designed and constructed will surely need sump-wells and expensive pumping machinery and the consequent annual expenditure of at least $12,000 for maintenance.

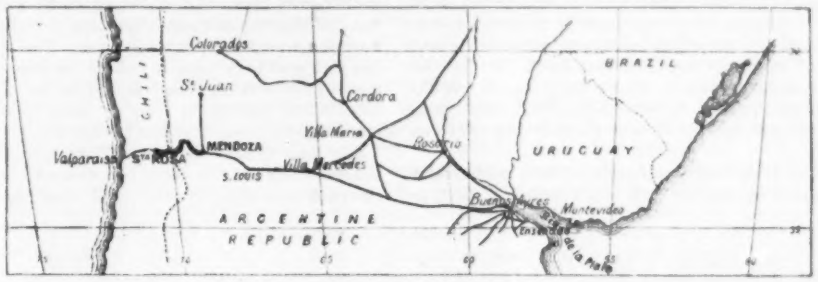
The present drain-section shows a rectangular opening 3½ ft. wide and 4½ ft. high to the spring of a 9 in. brick arch. The side walls are brick, 14 ins. thick, and they rest on 3 in. cross planks lying on a longitudinal 3 in. plank under each wall. The proposed section is exactly similar, excepting the addition of a brick-on-edge invert, laid to a radius of 18 ins. and lined with ⅝ in. cement mortar up to the springing line of the 9 in. arch.

The Transandine Railway.

From an article in *Engineering*, by Messrs. J. E. and M. CLARK & Co., the engineers and contractors for the construction of the Transandine Ry. we make the following extracts concerning this interesting work:

As will be seen from the general and detail maps, the line now building extends from Mendoza, the western terminus of the Argentine railway system, to Santa Rosa, in Chili, a distance of 149 miles. The distance from Buenos Ayres to Valparaiso, by this route, will be 850 miles, all of which is in operation excepting 109 miles from Mendoza to the frontier of Chili and the 40 miles from this frontier to Santa Rosa. The 428 miles from Buenos Ayres to Villa Mercedes were built by Messrs. CLARK, but the 220 miles extension to Mendoza was constructed by the Government. The gauge throughout is the 5 ft. 6 in. standard of Argentina. On the Chilian side the 53 miles of railway from Valparaiso to Santa Rosa has a gauge of 4 ft. 8½ ins.

The line now under construction is through a mountainous country presenting exceptionally difficult engineering problems. The starting point at Mendoza is 2,376 ft., and Santa Rosa is 2,704 ft. above sea level. But the lowest pass over the Andes between these points is 12,467 ft. above the sea, or 10,000 ft. above the terminals. The altitudes are given on the accompanying profile in meters, and the distances in kilometers. Careful survey



GENERAL MAP OF RAILWAYS IN ARGENTINE REPUBLIC.

demonstrated that a surface line with gradients that could be profitably worked would entail very considerable development and increase the distances exposed to snow and avalanches, without compensating advantages. The Abt rack system with 8 per cent. gradients was therefore adopted for a portion of the line, and tunnels used freely as a protection against the snow, with a 3-mile tunnel 2,000 ft. below the pass.

As finally arranged, the first 84 miles from Mendoza has maximum gradients of 2½ per cent. worked by adhesion; on the remaining 65 miles the engines can work either by adhesion or on the rack rail. The longest section of rack rail will be about 10 miles, at the summit.

Starting at Mendoza, the road reached Blanco Eucalada (13 miles), 3,347 ft. above the sea; at the 15th mile post the Mendoza River is crossed by 6 spans of 66 ft. each. At Boca del Rio (19 miles) the road enters the gorge of the Mendoza River and commences the ascent of the Andes, and heavy work begins. To mile post 57 the Mendoza River is crossed 8 times by viaduct and bridge, and finally the line reaches the Uspallata Valley, 5,577 ft. above the sea. The first of the series of tunnels is at Las Cuevas, 9,515 ft. above the sea. This is the Navarro No. 1, 2,265 ft. long, with a maximum grade of 8 per cent. Navarro Tunnel No. 2 is 2,460 ft. long, also with 8 per cent. grades. Just beyond there is the Las Cuevas tunnel, 2,790 ft. long, with a maximum grade of 6½ per cent.

The highest point of the railway is about the center of the summit tunnel, 10,466 ft. above sea-level and the frontier of Argentina and Chili is also crossed at the same point. This summit tunnel will be 16,620 ft. long, with an 8 per cent. grade on the Chilian side. Immediately beyond this tunnel is the Calavera tunnel, 12,100 ft. long, followed by the Portillo, a double turn spiral tunnel, 5,820 ft. long, continuing in tunnel through the Juncalillo, 4,185 ft. long, and the Juncal, 3,621 ft. long, with maximum grade of 8 per cent. The station of El Juncal is 31 miles from Santa Rosa and 7,218 ft. above the Pacific. From El Juncal the line follows the Rio Aconagua.

Upon the Chilian side about 12 miles of rack rail will be used on 8 per cent. grades as a maximum.

MAP SHOWING LINE OF TRANSANDINE RAILWAY.

On the portions worked by adhesion 2½ per cent. will be the maximum.

The special locomotives for the mountain section are being built by Messrs. Beyer, Peacock & Co. In working order they will weigh 45 tons, and haul a train of 70 tons gross up the 8 per cent. grades. The engines used for the adhesion portions of the line will be 6 wheel-coupled tank locomotives upon 10 wheels; the weight on the coupled wheels will be 28 tons. These engines will draw 140 tons gross over the 2½ per cent. grades.

The Transandine Ry. will be laid to a gauge of 1 meter, with 50-lb. rails on the adhesion portion and 55 lbs. to the yard on the combined rack and adhesion parts. Hard wood ties will be used, except where the rack rail is laid.

The earthwork is practically finished on two-thirds of the line, and the rail is laid 60 miles from Mendoza. It is expected that the line will be opened to traffic as far as the summit tunnels in 1891, and all the tunnels will be finished in 1893.

The bulk of the tunneling will be through hard rock. The work will be done by drills driven by electricity, with dynamos operated by hydraulic power. The Ferroux system of drills has been adopted as preferable to the Brandt or other hydraulic systems, chiefly on account of danger of freezing the water in the pipes outside the tunnels.

The Messrs. CLARK made the original surveys for the road, and obtained the concession and located and designed the works. The consulting engineers of the company are Messrs. James Livesey & Son.

Timber Supply vs. Railroad Consumption.

The last bulletin of Mr. B. E. FERNOW, Chief of the Forestry Division of the Department of Agriculture, contains important and interesting statistics on the consumption of timber by the railroads. Before fully reviewing this important publication the following points may be abstracted with profit:

In answer to circulars sent out to railways it is found that the round total of timber ties in use on railroads in the United States is nearly 516,000,000 and 80,000,000 are annually required for renewals. Including bridges and trestle work the annual consumption of timber on railways is computed at 500,000,000 cu. ft., requiring the cutting of the best timber from over 1,000,000 acres of forest land per year. To meet this demand, under our present wasteful management of timber land, the area to be preserved for this purpose would probably exceed 50,000,000 acres, or more than 10 per cent. of our present forest area.

As railway managers prefer "hewn" ties, and "one to the cut from small trees," the timber consumed by railroads, or 20% of the total annual consumption, is taken from the young growth. Then 80% of all ties are oak, the most valuable of all our timber. Reliable investigation shows that in the Kentucky forests, when 40% of the natural growth is white oak, the new growth of oak is only 5% after the land has once been cut over for ties.

The consumption of pine from the forests of Wisconsin and Michigan is also enormous. And while some of us look to Canada for future supplies, Mr. FERNOW points out that Canada too is becoming alarmed at the rate at which her forests are disappearing. At the Congress of the American Forestry Association, at a recent meeting at Quebec, Lt.-Gov. ANGER, of Quebec Province, said that between 1867 and 1889 60,000,000 cu. ft. of wood were cut down in Quebec alone. In California, in 1889, it is estimated that $25,000,000 worth of timber was destroyed by fire, the greed of speculators and the efforts of herdsmen to secure pasturage for flocks.

The New Lake Michigan Intake of the Milwaukee Water-Works.

Milwaukee is notable among American cities for not having introduced a general public water supply until 1873, when her population must have been upwards of 80,000. This is all the more striking when we consider that for a western city Milwaukee has been settled many years, there having been a population here of 1,712 in 1840, 20,061 in 1850, and 71,440 in 1870, about the time when the construction of the works was begun.

The supply introduced in 1873 was taken from Lake Michigan, at a point 2,100 ft. from the pump-well on the shore, a 36-in. intake pipe extending into 18 ft. of water at ordinary low level. At present Allis pumping engines with a daily capacity of 30,000,000 galls. force water to a 21,000,000-gall. reservoir, and a stand-pipe 4 ft. in diameter by 130 ft. in height.

Contracts have recently been let for a new intake and pumping engine and the former, at least, is now well under way. The intake will extend about 8,000 ft. into the lake to 60 ft. of water.

The cost of constructing and maintaining a crib in such deep water and of lighting it at night would be great, so great, in fact, that it is probable that the intake would have been necessarily located nearer the shore had not a novel and ingenious expedient been devised by the City engineer, GEO. H. BENZENBERG. Instead of carrying a tunnel beneath the bottom of the lake to the outer extremity of the intake the tunnel terminates in a shaft 3,157 ft. from the shore end. Over the shaft a crib is built in 25 ft. of water, and from this two parallel lines of 5-ft. cast-iron pipe are laid on the lake bottom in a trench for 5,000 ft. to 60 ft. of water. Here the pipes turn upward and are protected by submerged cribs about 15 ft. high. The large crib, marked *A* on the accompanying illustrations, is inside the navigation line, while the submerged cribs, *B B* have 45 ft. of water above them. Had the tunnel been continued the full 8,000 ft. another shaft would have been necessary and a crib in 60 ft. of water. As now planned this difficult and costly piece of work has been avoided, but in place of it and the 5,000 ft. of tunnel which otherwise would have been constructed 10,000 ft. of 5-ft. cast-iron must be laid in a trench dredged in from 25 to 60 ft. of water. This part of the work has not yet been started, and when it is, it will be watched with great interest.

The tunnel is in two sections, the first of which extends from the shore shaft to a distributing well near and connecting with the pump-house, and is 183 ft. long from center of well to center of shore shaft. The bottom of this section is 17.5 ft. below city datum and 31 ft. below the surface of the ground. Near the shore shaft the shore section of the tunnel is provided with a gate and a gate well giving access to it. In the contract the shore tunnel, distributing and gate-well were let together at the same rate per lin. ft., their total length being 260 ft.

The next contract was the shore shaft and connections, with a total length of 153½ ft. The excavation for the shaft extends 140 ft. below city datum and 153.5 below the surface of the ground. This shaft has an internal diameter of 10 ft. and it and the distributing and gate-wells are to be lined with four rings, or 18 ins., of brick work. The shafts and the well will each have a ladder formed of ¾-in. round iron built into the masonry 16 ins. apart vertically, and making a step or rung 18 ins. long, standing out 6 ins. from the brickwork.

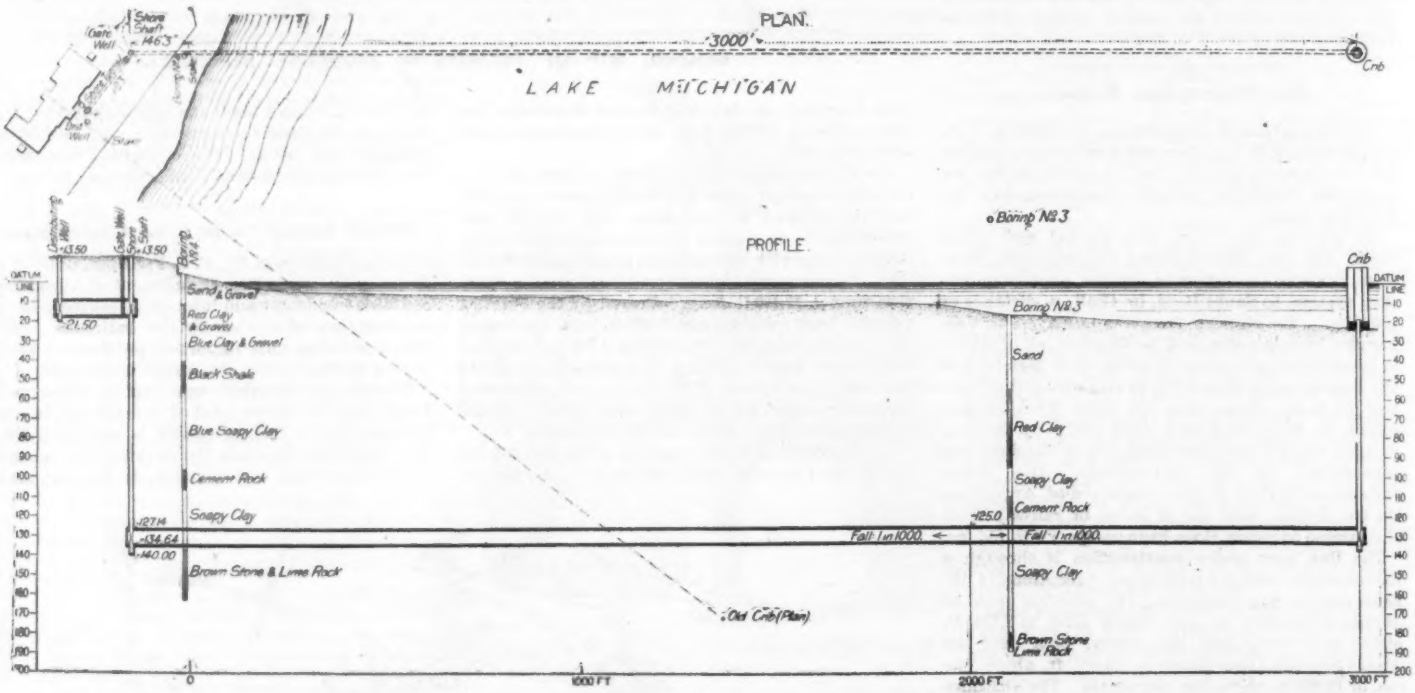
The lake tunnel will be 3,157 ft. long, including the extensions at the shaft. It extends through a compact clay, just beneath solid rock from 12 to 15 ft. in thickness. Its bottom is 134.64 ft. below datum at the shore shaft, and 133.5 at the lake shaft, falling at the rate of 1 ft. in 1,000 each way from a point about 2,150 from the shore tunnel. Both the shore and lake tunnels have an internal diameter of 7.5 ft., and a shell consisting of three rings, or 13 ins., of brick masonry. The arch of the shell will be set up 2 ins. to allow for settlement.

The upper part of the lake shaft, from about 70 ft. below city datum to the bottom of the crib, will be a 10-ft. cast-iron cylinder. During construction this cylinder will be carried through the centre of the crib up to a point 6 ft. above datum. The cylinders are to be in sections not less than 6 ft. long, with shells not less than 2 ft. thick, and with grooved and planed interior flanges not less than 6 ins. wide and 2¼ ins. thick. The joints between the sections are to be made air and water tight by bolting the flanges together with not less than 52 bolts, 1¼ ins. in diameter. All the boltholes will be drilled and the bottom of the cylinder will have no flange, as it will rest upon the brickwork of the shaft below. Below the cylinder the lake shaft will have an internal diameter of 8½ ft., and will be lined with brick in the same manner as the shore shaft. It will continue up the first section of the iron cylinder against its upper, and only, flange. Each shaft will have a brick bottom 18 ins. thick, and will be carried 4 ft. below the bottom of the tunnel. At each shaft the tunnel will continue as an extension 10 ft. beyond it, and be closed by an 18-in. bulkhead. The bottom of the excavation for the lake shaft will be 139 ft. below datum. The brick shell will extend upwards to 70 ft. below datum, and the cylinder to a point just above the timber floor of the crib, about 20 ft. below datum.

Crib *A*, at the lake end of the tunnel, and over the lake shaft, is a twelve-sided polygon in plan, with an outside diameter of 56 ft. It is of timber, with a concrete bulkhead 18 ft. thick and a central well, hexagonal in plan, 20 ft. in diameter and 29 ft. deep. There are six ports, each provided with a wedge-gate and a gate-well extending to the top of the crib. Two of the ports are 5 ft. sq., and will form the connection between the 5-ft. extension pipes and the crib, lake shaft and tunnel. Four of the cribs are 4 ft. sq., and will be used to admit water directly to the crib from this point, should that ever be necessary. Ordinarily, however, water will be admitted to the crib directly from the 5-ft. pipes, and will stand in the crib at the same level as in the lake, less the head lost in passing through the 5,000 ft. of pipe. The bottom of the crib will consist of four tiers of 12 × 12-in. pine timbers, and the inner and outer walls of the crib, and the walls dividing the crib into six water tight compartments will be of timber of the same material and size, as will the walls forming the ports. The outer walls of the crib will be covered with 4-in. oak plank, from the bottom to 5 ft. above the water line, and the angles will be protected from top to bottom by ⅜-in. iron plates, 2-ft. wide, securely bolted to the crib. All of the timbers in the crib are to be drift bolted to those below by bolts 20-ins. long and 1¼-ins. sq. The concrete in the bulkhead will extend 3-ft. above the water line, and will be composed of 4 parts broken stone, 2 of bank sand, 1 of cement and sufficient water to mix in a Caldwell mixer. The broken stone must be as nearly cubical as possible and not more than 2 or less than ¼-ins. in diameter. Good quarry stone of not more than ½-yd. cubical contents, but not nearer to each other or any wall than 18 ins. may be placed in the concrete. The date set for the location of the crib was Sept. 15, and the point specified is 3,140 ft. due east from the shore shaft, with the two pipe connection openings facing east. The contractor is bound to drive 24, or less, 40-ft. piles around the crib, as the City Engineer may direct.

The two lines of 5-ft. pipe will be laid on the lake bottom in a trench 8-ft. deep and 18 ft. wide, and each will turn up at the outer end and terminate in a crib about 15 ft. high. The contracts for the cribs will not be let until next spring, and will probably amount to about $35,000.

The pipe will be laid by divers in sections of 60 ft., five lengths to a section. The joints for the 60-ft.



PLAN AND PROFILE OF NEW LAKE TUNNEL FOR MILWAUKEE WATER-WORKS.

sections will first be made on shore, then withdrawn and finally reëntered when the sections are in place, the pipe being drawn together by clamps and screw-bolts, which remain permanently. All the submerged pipe in Milwaukee has been laid in this way, and no leaks have occurred. In good weather it is expected that one, and sometimes two sections of pipe will be laid in a day.

The contracts for the work as let thus far have been as follows:

Shafts, tunnels, &c., to Shailer & Schinglan, Chicago, for	$122,000
Crib *A*, complete in place, to J. O'Neill, Milwaukee, for	34,000
Cast-iron pipe, Addyston Pipe & Steel Co., Cincinnati, for	126,000
Dredging trench, to C. H. Starke, Milwaukee, for.	65,000
Laying pipe, to Shailer & Schinglan, for	53,500
Total	$400,500

The prices per unit were as follows:

Shore tunnel, with gate and distributing wells and connections, $30 per lin. ft.; shore shaft, $55 per lin. ft.; lake shaft, $145 per lin. ft; lake tunnel, $26.50 per lin. ft.; rock excavation, $12 per cu. yd.; 5-ft. cast-iron pipe, $28.45 per ton, delivered on ground; dredging trench, 8 ft. deep, 18 ft. wide and 5,000 ft. long, $13 per lin. ft.; laying 10,000 ft. of pipe trench in from 25 to 60 ft. of water, $5.35 per lin. ft.

All of the work, except the dredging and pipe-laying, was under way Sept. 4. The shore shaft was down 85 feet in good material, no pump having been required. On Sept. 20 the shore shaft was down 115 ft. to the "cement" rock. The tunnel and shafts are to be completed by June 1, and the balance of the work by Nov. 1, 1891.

In connection with these improvements a contract has been let to E. P. Allis & Co., of Milwaukee, for a triple expansion pumping engine with a daily capacity of 18,000,000 galls. and a duty of 125,000,000 ft.-lbs. per 100 lbs. of coal consumed in furnaces, without deductions or allowances of any kind. The test will be for 24 hours, under exactly the same conditions as will exist every and any day the engine is in operation. This is undoubtedly the hinhest contract duty for a pumping engine ever called for, and if the trial duty is as far in excess of the contract duty as is general at such tests it would not be surprising if this engine should take the lead in duty trials. The contract price of the pumping engine together with five steel boilers is $76,000.

We are indebted to Mr. GEO. H. BENZENBERG, City Engineer of Milwaukee, for the above data and the accompanying illustrations.

The Visp-Zermatt Abt Railway.

The Zermatt Valley in Southern Switzerland has long been noted for the grandeur of the mountain scenery at its head, and of late years over 12,000 travelers have annually made the long and difficult journey from Visp on the Rhone River to Zermatt, which is situated on a small plateau at the foot of the Monte Rosa and Matterhorn groups of mountains. The scenery is wild and rocky in the extreme, and the whole valley is so rough and uneven that the Swiss say the fowls are shod with spikes to keep them on the slopes. This is the valley where the people are so poor that when a number of brothers have reached the age of manhood, they hold a kind of family raffle to see which shall marry; the fortunate one chooses a wife, and all the others help support her. The chief reliance of the people are tourists, to a greater extent here than in other parts of the country, and the new railway will probably greatly better the fortunes of the inhabitants.

The first part of the route, from Visp to St. Nicolas, is 11.18 miles long, and without anything approaching the dignity of a road. All merchandise is carried on mules or horses over a rough, narrow path. In the neighborhood of each little cluster of houses the way is paved with cobble stones, set with a perfect disregard of the comfort or safety of the pedestrian. As wretched pavements may exist on some of the Brooklyn streets, but it is doubtful if they can be equaled elsewhere.

The grandeur of the scenery which draws a great number of tourists annually up the valley can be partly understood by thinking of the difficulties of the walk from Visp to St. Nicolas. From St. Nicolas to Zermatt is a fair carriage road, and by paying $3 to $5 it is sometimes possible to obtain a seat in a mail cart or private droschke, which covers the remaining 16 miles of the journey in about 4 hours.

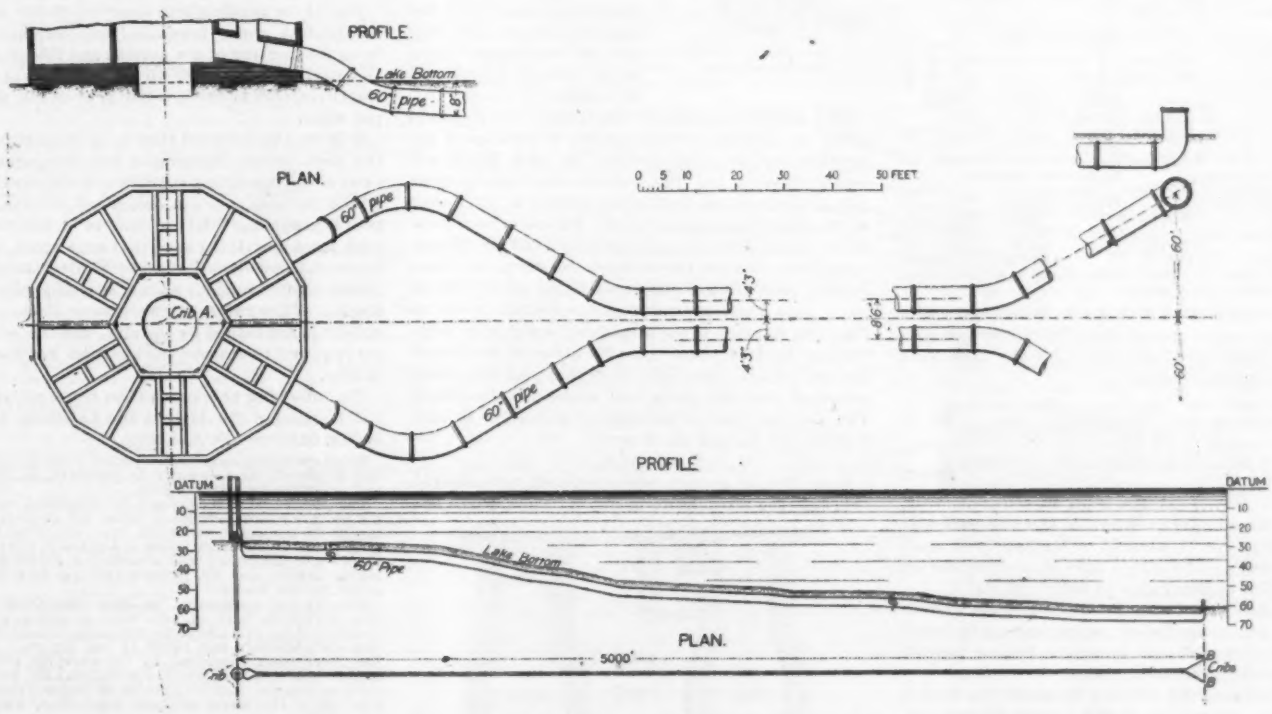
In December, 1886, Masson, Chavannes & Co., bankers at Lausanne, and the Banque Commerciale at Basle received a concession from the Federal Council for constructing a railway from Visp to Zermatt. A little later a company with a capital stock of $500,000 was formed; the necessary money above this sum is met by notes.

Surveys of the route were made in 1887 and 1888 by engineers of the Jura & Simplon Ry. under the direction of M. AUGUSTE PERRY. The survey of the valley was tied to the government triangles and cost $1,130 while the leveling, also connected with government bench marks, cost $340. The stadia topograpical survey was made for contours 5 meters (16 ft. 4.8 ins.) apart except on very rough ground where they were twice as close. This work cost $2,344.

Several lines were traced out on these plans. An adhesion railway was possible with a maximum grade of 4.5% and minimum curves of 60 meters (197 ft.). The difference in altitude between Visp and Zermatt is 955 meters (3,096 ft.) and it was very difficult to locate a line of this sort to surmount this height.

The proposed line had a total length of 22.294 miles, of which 4.16 miles, or 18.8 %, are level. About 65 % of the line are tangents. The total cost of construction was estimated at $1,170,000, or about $52,160 a mile.

At the close of 1888, M. JULIEN CHAPPUIS, the designer of the important hydraulic improvements at Geneva, and M. ERNEST DE STOCKALPER, one of the engineers of the Goeschenen tunnel, on the Gothard line, proposed to construct the line as a rack road with a maximum grade of 12 %, the cost being estimated at $680,000. The plan was adopted and the Abt system unanimously selected by the engineering staff as the most suitable for the work in hand.



THE CRIB AND THE 5-FOOT PIPE EXTENSION.

The gauge is 1 meter. The curves on the line are shown in the following table:

No.	Radius. Ft.	Length. Ft.	No.	Radius. Ft.	Length. Ft.
1	194	328	5	820	1,311
1	197	49	1	869	793
106	262	15,663	2	902	1,132
109	328	17,241	5	984	942
4	361	1,033	1	1,148	341
2	394	479	3	1,312	1,703
1	410	138	8	1,640	1,741
1	427	217	2	2,133	833
6	492	1,194	2	3,281	551
18	656	3,570			
1	722	554		Total	60,571
1	788	738			

The grades in the adhesion part of the railway vary from 0.15 to 2.5%, and have a total length of 70,773 ft., while the level portions amount to only 19,574 ft.

The rack-rail grades are as follows:

6%	1,262 ft.	10%	4,562 ft.	12.5%	1,888 ft.
7%	1,368 f.	10.3%	925 ft.		
7½%	2,083 ft.	12%	5,214 ft.	Total	18,042 ft.
9%	1,040 ft.				

The adhesion and rack grades are connected by curves of 1,000 meters (3,281 ft.) at all places save two, where the radii are 2,461 ft. long. The total length of the rack-rail is 24,475 ft., the 5,833 ft. in excess of the lengths depending entirely on the pinions, consisting of the entering and leaving rails of each rack grade and a few short racks placed on the adhesion grades for safety.

The rails are of the Vignole type, weighing 48.4 lbs., 4.32 ins. high, 1.97 ins. wide at the head and 3.54 ins. at the base, with a 0.35-in. neck. The sec-

tion contains 4.805 sq. ins. The angle bars are 23.6 ins. long, weigh 34.1 lbs. each, and are fastened by 4 bolts weighing 0.88 lbs. each. The rails are usually 34.4 ft. long on the curves, they are cut a little longer for outer rails and shorter for those inside.

Each rail is carried by 13 soft steel ties, 2.87 ft. apart in the center of the rail, 1.61 ft. apart at the joint, and with 2.08 ft. between the second and third tie, numbering from the joint, which is of the suspended type. The ties are 6 ft. long, 9¾ ins. wide at the base and 3 ins. high. The metal of the 4.3 lin. ins. upon which each rail rests is 0.32 ins. thick; the section is 37.2 lbs. per yd. The ends of the tie are bent upward at an inclination of 1 to 20 for a distance of 1.8 ft. from each end, by means of hydraulic presses. The rails are carried on blocks and are fastened at a slight inward inclination by hook bolts.

The racks are of the usual Abt type, consisting of 2 parallel plates 1 in. thick on the steep and 0.8 in. on the light grades. The entering and leaving racks are supported on elliptic springs instead of the more usual spiral form.

The locomotives are of the type illustrated in ENGINEERING NEWS for May 22, 1886. Their principal dimensions are given below:

Gauge	3.28 ft.	Heating surface:	
Diam. inside cyls. for rack pinions.	13.16 ins.	Firebox	70 sq ft.
Stroke inside cyls.	17.71 ins.	Tubes	635 sq. ft.
Diam. outside cyls. for adhesion grades	12.6 ins.	Total	705 sq. ft.
Stroke outside cyls.	17.71 ins.	Grate area	12 9 sq. ft.
Diam. driving wheels (2 pr.)	3 ft. 3 ins.	Boiler pressure	176 lbs.
Diam. trailing pony wheels (1 pair)	23.38 ins.	No. of tubes	166
Dist. between drivers	6.43 ft.	Outside diam. tubes	1.77 ins.
Dist. between pinions	3.05 ft.	Length of tubes	8.2 ft.
Wheel base	13.45 ft.	Thickness cyl. walls	0.51 ins.
Diam. of pinions	2.26 ft.	Thickness copper firebox	0.59 ins.
Pitch of teeth	4.72 ins.	Water in boiler	70.6 cu.ft.
		" tanks	88.2 cu.ft.
		Coal carried	35.3 cu.ft.
		Weight, empty	25.9 tons.
		" loaded	31.96 tons
		Max. wheel load	11.3 tons.

All the rolling stock is of the American type, with four-wheel trucks, center aisles for passenger cars and step platforms at the ends. All the cars have the following dimensions:

Box.		Body (iron).	
Length, total	34.5 ft.	Length of frame	39.4 ft.
Breadth, "	8.5 ft.	Width between sole-bars	5.25 ft.
Height of center of roof above rail	10.3 ft.	Distance between truck centers	26.25 ft.
Body (iron).		Distance between truck wheels	5 ft
Length between buffer ends	42.3 ft.		

The passenger cars have double seats on each side of the aisle; some of them have baggage and mail-compartments, while others have open sides and are arranged like summer cars on street railways

The brakes are of the Hardy-Smith continuous type, and can be applied by the engineer or by hand. There are also rack and pinion brakes on most of the cars used on the rack grades.

It is hoped that the line can be opened by June 1, 1891. When completed it will be the longest railway of the kind in the world, and will probably prove a very profitable investment. Zermatt and the Matterhorn are among the most famous "sights" on the continent, and any one familiar with the way in which the average tourist follows his Baedecker when strength permits can predict a heavy traffic over the line during the summer months. The difficulties of location and construction overcome in building the railway make it an interesting engineering feat, and the wonderful scenery along the upper portions certainly repays the outlay of about $6.50 for a return ticket.

Municipal Engineering in Liverpool.

[*Continued from page* 291.]

SEWERS.

During the past 17 years, the expenditure for sewerage works has been approximately $1,703,000.

The new brick sewers are now constructed of the form shown in Fig. 1. The bricks are all molded to the respective radii, and in some cases the invert is lined with best quality radiating blue brick.

A large part of the expenditures are for repairing old sewers. Where a branch sewer met a main line at the same invert level, this has been altered wherever possible by raising the invert level so that it outlets into the main at its proper relative level and running the gradients out to meet the ordinary gradient of the branch sewer. In repairing the masonry, it is usual to rake out the joints of the brick work and repoint with cement mortar composed of 1 part of Portland cement and 1 part of sand. In many cases a new invert is formed by a first layer of 1 part Portland cement and 2 parts of sand, followed by a finishing coat of equal parts of cement and sand.

Repairs have been frequently necessary in brick sewers laid in rock tunnels where the headings were too large for the masonry. The sewers were often built so that a large air space remained between the brick work and the roof. In repairing such places, a mortar filling was placed in the voids, and usually the invert was lined with cement or blue brick at the same time. Sometimes the old sewers were made by simply tunneling out of the sandstone a rough channel of quadrilateral section. In repairing such a drain, the tunnel is first brought to the proper grade and then the brick work put in. A large amount of concrete filling was always necessary in such cases.

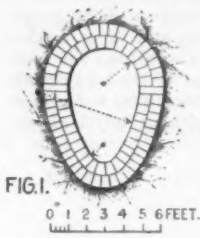


FIG. 1.

Prior to 1871, no ventilators were used upon the main sewers in the city. At that date some 1,000 Archimedian screw ventilators, 6 ins. in diameter, were connected with the branch sewers, but they proved inefficient, and were allowed to fall out of repair.

The present system of ventilating is by means of grids or man-hole covers, spaced 80 yds. apart approximately, the clear opening in each being not less than 63 sq. in. Fig. 2 shows the arrangement adopted where the ventilating grating is fixed over a chamber constructed at the side of a man-hole while Fig. 3 shows a man-hole cover and ventilator combined. Where the distance between the man-holes is more than 80 yds., ventilating grids (Fig. 5) have been fixed on special shafts over the sewer so that this distance is the maximum separation anywhere. In 1885, there were 249 miles of ventilated sewers; all new lines built since that year have been provided with the grids and man-holes described. The average cost of ventilating appliances is estimated at 12 cts. per yd. of sewer.

GUTTERS.

Since 1880, all gutters when repaired were altered over into the form shown in Fig. 4. This section has been found easy to clean and admits very little detritus into the sewers.

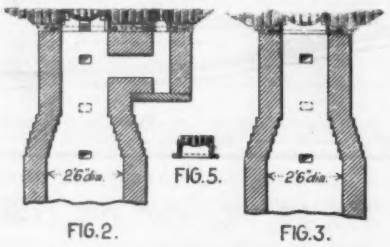


FIG. 2.

FIG. 3.

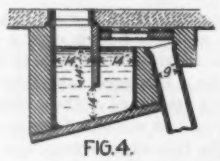


FIG. 4.

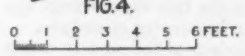


FIG. 5.

HOUSE DRAINAGE.

Since 1883 all new buildings erected have been drained in conformity with sanitary regulations prepared by the City Engineer.

Except in the center of the city, the houses are connected on the back drainage system, the drains discharging into a passage sewer at the rear of the premises. In this way the number of pipes under the house itself is reduced to a minimum.

FLUSHING SEWERS AND DRAINS.

All main sewers that are not self-cleansing are periodically flushed by large movable tanks placed over a man-hole on the sewer. These tanks contain 1,800 galls. of water, and discharge their contents into the sewer through a valve at the bottom of the tank in 28 seconds. The cost of this work is about $5,850 per annum. All passage sewers are flushed 4 times annually by special gangs, either from chambers at the head of each sewer or by hose connected with hydrants fixed in convenient positions, and, in addition, they are indirectly flushed twice annually by the private drains flushing gang. The cost of this work is about $5,360 per annum. In December, 1880, on the recommendation of the engineer, the health committee resolved to flush all private drains twice annually, free of cost to the occupiers, and oftener on payment of a small fee, regulated according to the ratable value of the premises, and this work has since been regularly carried out. It is so arranged that a flushing gang visits each house in the city once every 6 months. The staff for this work comprises a flushing inspector, a foreman and 16 gangs of 3 men each. The drains, water-closets and soil-pipes within the curtilage of all premises are flushed by hose attached to hydrants fixed at convenient distances in the passages or adjacent streets.

This work costs about 12 cts. per house for each flushing.

Since 1885 all main sewers have been periodically inspected by special gangs. This plan has been found superior to that of examining only during repairs or extensions.

ARTISANS' DWELLINGS.

One of the greatest and most beneficial works accomplished under municipal superintendence has been the housing of the artisan and laboring classes in dwellings possessing all the most recent sanitary improvements at the low rental of 54 cts. per room per week.

It is well understood that in all large cities one of the most cruel, intolerable and dangerous social evils is the insanitary condition of the dwellings in which the very poor are compelled to live. Liverpool is grappling this problem in a practical way with most gratifying results. Large areas, occupied by the filthiest dens, have been cleared and immense blocks erected in their places, specially planned for renting at low rates to the poorer classes. These buildings are owned by the city, and the occupants are required to observe the strictest sanitary regulations.

The following notes are taken from an article on "Rehousing of the Artisan and Laboring Classes," by Mr. CLEMENT DUNSCOMBE.

These dwellings have been erected from designs by the City Engineer, Mr. CLEMENT DUNSCOMBE, M. Inst. C. E., and under his superintendence.

The designs, as well as others for dwellings suitable for the poorer classes, capable of being let at rents of 24 cts. and 30 cts. per room per week, were exhibited at the International Health Exhibition in London in 1888; the corporation of Liverpool was awarded a diploma of honor for the exhibit, and Mr. DUNSCOMBE was awarded a gold medal for the designs.

The city had confiscated an area comprising 22,487 sq. yds., of which 3,717 sq. yds. were occupied by public streets and the remainder by low class, unhealthy dwellings and buildings, and yards in use for trade purposes. The population displaced by the carrying out of this scheme was 1,310, of which population 1,100 were of the working classes; and the number of people living on this area, under the worst sanitary conditions, was at the rate of 282 per acre.

After the site was cleared and filled up to a proper level it was laid out for the erection of artisans' and laborers' dwellings and offered by auction, but no bids could be obtained for it; and, as private enterprise could not be induced to take the matter up, the corporation was therefore reluctantly compelled to erect these dwellings on a portion of the site in 1875. Again, in 1884, the remaining area unbuilt upon was offered by auction, and although an extremely low reserve price was fixed so as to admit of buildings being erected upon it to pay a moderate rate of interest, this further effort on behalf of the corporation was likewise unsuccessful.

The site upon which the dwellings have been erected is bounded on every side by streets, and contains 9,195 sq. yds., of which 3,924 sq. yds. are occupied by dwellings and 5,271 sq. yds. in approaches and in a quadrangular open court suitably laid out. Tramways, affording cheap means of communication with all parts of the city, pass along 2 of the streets.

The entire area occupied by buildings, after being excavated to the requisite depths, was covered with a layer of Portland cement concrete averaging 9 ins. in thickness, the concrete foundation for the walls being carried to a greater depth, and for a width of from 3 to 5 ft., to receive the various footings to the brick walls. Above the ground level a damp-proof course of asphalt is laid over all the walls throughout.

The quadrangle is laid out with wide foot-walks and a 15-ft. carriage-way round the buildings. The central portion of the quadrangle is inclosed by a low wall and iron railing provided with entrance gates in convenient positions. The remainder is laid out as a playground and finished in Portland cement concrete.

The footways are likewise laid with 6-in. Portland cement concrete, and the carriage-ways are formed with a similar foundation, the surface being finished in compressed natural asphalt.

All the streets surrounding the dwellings have a 6-in. Portland cement concrete foundation, and are paved with syenite sets, the joints being filled with dry shingle and grouted with a mixture of pitch and creosote oil, the footwalks being finished in compressed asphalt. The site is therefore practically impervious.

The buildings are 5 floors in height and divided by party walls into 13 separate dwellings, each of 75 ft. frontage and 36 ft. in depth, outside measurements. They are arranged so as to admit of a free circulation of air around them. There are 5 entrances to the quadrangle, provided with ornamental wrought-iron gates, approached from the

surrounding streets. Two of the blocks have shops on the ground floor, with spacious basements, lavatory and water-closets connected with the shops by staircases. These blocks have only 4 floors of tenements above them. All the other blocks are entirely devoted to dwellings, and have no basements. Each dwelling has a separate entrance from the quadrangle and a common staircase, giving access to the corridors and tenements right and left to each floor.

There are in the 13 dwellings 271 tenements and a superintendent's house, made up as follows:

	No. of rooms.
86 three-roomed tenements	258
164 two-roomed tenements	328
21 one-roomed tenements	21
Superintendent's house	4
Total	611

The three-roomed tenements are arranged into a living room, 13 ft. × 12 ft. 4 ins.; one large bedroom, 15 ft. 3 ins. × 9 ft. 7 in., capable of being divided into 2 bedrooms by a movable screen, with separate entrances to each half; one bedroom, 13 ft. × 8 ft. 6 in. The two-roomed tenements are arranged into a living room, 13 ft. × 12 ft. 4 ins., and one bedroom, 15 ft. 3 in. × 9 ft. 7 in., capable of division as above described. The one-roomed tenements are arranged as a living room and bedroom combined, 12 ft. × 12 ft. All the rooms are 9 ft. in height.

The twelve shops have a frontage of 12 ft. 6 ins. each, a depth of 32 ft. and an average height of 11 ft., with basements 9 ft. in height under the entire area of the shops.

Entering from a lobby out of the corridors, and adjacent to the sculleries, water-closets, slightly projecting beyond the main line of buildings, are provided, 2 on each floor, for the joint use of the 4 tenements. These water-closets are thoroughly disconnected from the tenements; they have constant through ventilation and pivot-hung windows, and are fitted with Bristol glazed flush-out closets of the best construction, and water-waste preventing cisterns.

There are 13 staircases, one to each dwelling. The stairs and landings are of stone. The landings to the stairs are open to the quadrangle front for their entire height, and project from the main building, forming a balcony protected by a wrought-iron railing. The stairs and corridors are amply lighted by the windows of the sculleries and by these openings, thus affording through ventilation from front to back of each dwelling.

The floors of laundries, sculleries, corridors, and water-closets are of Portland cement concrete; the floors to living rooms and bedrooms are boarded, but are specially constructed to prevent, as far as possible, the spread of fire.

The dust and ashes only on each floor are disposed of through a ventilated chute formed in the angle of the lobby leading to the water-closet. This chute terminates in a receptacle placed in position on the ground floor, and there are 2 connections in it in the corridors on each floor. Provision is made for all other refuse being deposited in special orderly bins external to the building and placed in the railing of the inclosure in the quadrangle.

In addition to the above accommodation, each tenant will have the sole use, for a fixed day or portions of days, of a spacious laundry placed centrally on each floor, with 2 entrances from the corridors, and intended for the use of the 4 tenements on that floor. The laundry is lighted by a large bay window, which is divided into several pivot-hung sashes all opening for ventilation. It is fitted up with double wash-troughs and a copper, water being laid on to each. A galvanized iron hood is placed over each copper and connected with the flue, so that the steam may be speedily carried away.

On each side of the laundry, on every floor, immediately leading from the corridor, is provided a double sink of Bristol glazed ware, with hard wood drainers, with water laid on to each, being one sink for the use of each tenant. An additional water tap is placed in the corridors on each floor near the sculleries.

The interior of the tenements is made as attractive and cheerful as possible. The walls of all the rooms are plastered and finished in distemper. The fittings to each tenement comprise a series of useful articles, thus dispensing to the fullest extent with movable furniture. A special combination dresser, larder, coal bunker and closet are provided in each living room. The larder is fitted with slate shelves, meat-hooks, hangers, etc., and is ventilated by openings into the corridor filled in with terra cotta ventilators, covered on the inside with perforated zinc. There are also attached cup rails, small and large cupboards, drawers, etc., and underneath a coal bunker with sliding doors in the living room and fitted with a small door in the corridor, through which the coals can be delivered.

Hat and coat rails are fixed in all the rooms, and in the bedrooms shelving and hanging closets, and in the divisible bedrooms, which are provided with 2 entrances, one of which forms a convertible closet when not required as an entrance.

The sashes of all the windows throughout open for their entire area. They are divided into three parts, the lower sashes being double hung, and the upper sash pivot hung. The lower portion of each window is divided into small squares, and is glazed with cathedral-tinted glass, giving both a cheerful appearance and at the same time acting as a window blind. The windows of all the living rooms and bedrooms are fitted with Venetian blinds, stained and varnished.

Adequate provision has been made for the admission of fresh air through the ventilators in external walls and corridors, and the extraction of foul air is provided for through flues in the chimney breast fitted with mica flap ventilators.

Each living room has a specially designed cast-iron combination mantel and over-mantel and a cooking range fitted with oven, plate rack, and other useful accessories. All parts liable to heavy wear are made in wrought-iron, such as the fire-bars and fall-down bars of fire-grate and draw-out fret, etc. At the back of the fire grate a hot-air chamber has been constructed, which is supplied with cold fresh air through perforated terra cotta air bricks fixed in the external walls and thence through a cavity formed in the wall leading to the air chamber. The air, when warmed, passes through pipes leading to the living rooms and bedrooms, the supply being regulated by cast-iron hit-and-miss ventilators placed in the walls of these rooms.

The buildings have been erected in Liverpool gray common bricks, with splayed red pressed brick arches and window jambs, molded labels over windows and panels under same, cornices and bands, and red pressed bricks used sparingly in a few other places. Red terra cotta has been used in the main entrance doorways and dormers. Wrought-iron balconies are introduced in connection with the main staircase of each dwelling in the quadrangle front. The roof is covered with Welsh slates from a selected quarry, and there are Yorkshire stone sills to all windows projecting 1 ft. from the face of the wall for plants in pots or window boxes, each being fitted with neat wrought-iron guard rails.

The sewers in the streets surrounding the dwellings are 3 ft. by 1-ft. 10-in. brick sewers. They are of recent construction, and thoroughly ventilated at frequent intervals by means of open grids. They receive all the waste and soil pipes from the buildings, with the exception of the block fronting Cazneau street.

The drains in the quadrangle consist of glazed earthenware socket pipes, caulked and jointed in Portland cement, 6, 9, and 12 in. in diameter respectively. One of these takes the waste and soil pipes from the closets of the shops above referred to, and eventually discharges into the main sewer. The others only receive the water from the roofs and the surface water of the quadrangle. The former drain is ventilated by a special 6-in. ventilating shaft fixed to the building, discharging well above the roof line, and is furnished at its highest point with an automatic flush tank of 300 galls. capacity, constructed in brickwork.

The remaining drains in the quadrangle are also ventilated. The whole of the waste pipes from the buildings are disconnected from the drains, and discharge into ventilated 4 × 4 in. cast iron pipes attached to the buildings, and they are caulked and jointed in red lead. These pipes again discharge over the water line of a trapped gulley at the foot of same, fixed in the footpath within the building line and covered with a grating acting as an air inlet.

The closets discharge into an external 6-in. socketed and lead-jointed cast-iron soil pipe, with special junction cast on, of sufficient length to reach inside the wall of the building to receive the outlet from the closet, the joint being made within the wall line. These soil pipes continue above the roof line the full diameter, and terminate with a cowl on top, and are supplied with fresh-air inlets. Both the siphon and improved flush-out closet are of Bristol glazed ware, the former having an air-tight inspection cover.

The waste pipes from the sculleries, sinks, and wash-troughs are formed entirely of Bristol glazed pipes 1¾ in. in diameter, thus dispensing with lead piping. They are fitted underneath with a siphon of the same material, furnished with an air-tight inspection inlet, with the requisite piping, and discharging external to the buildings, as already described.

The public drains are flushed at frequent intervals, and all the private drains within the city are flushed twice annually, free of cost, by the corporation, and oftener on payment of a small fee by owners of the property. These regulations will equally apply to this block of buildings.

A constant service supply is laid on to every floor of the dwellings, to sinks and laundries, and in corridors. The taps in the corridors are provided with half coupling on nose for hose pipe, rendering them capable of being used in case of fire on any floor. Fire hydrants are also fixed around the quadrangle, and 2 double drinking fountains are provided. All water for domestic use is drawn direct from the mains. A 500-gall. slate storage cistern fixed in the roof of each dwelling supplies the 6 gall flush regulating cisterns fixed over each water-closet.

The gas supply is under the control of the superintendent, in his general office, by means of a wheel attached to a valve on the main. Pressure-gauges are also fixed in his office to facilitate the adjustment of supply, and a ¾-in. by-pass is fixed on the valve to prevent the total extinction of the lights. Branches to each of the 13 blocks are laid from the main, with a stop-cock fixed on same on the outside of the building inclosed in a suitable iron box. Governors are fixed to all the lights, limiting the consumption to 3 cu. ft. per hour of 29-candle gas, with the exception of the outside lamps, which are rated at 4 cu. ft. per hour.

Cost of Dwellings and Estimated Returns.—The total estimated cost of the dwellings, including the market value of the site, viz., 9,195 yds. of land, is $340,000. It is estimated that at least the following moderate rents will be readily obtained, viz.: Three-roomed tenements, $1.44 per week; two-roomed tenements, $1.08 per week; one-roomed tenements, 54 cts. per week.

These rents are exclusive of the charge for gas used in the living-room, but inclusive of all rates and taxes, which will be paid by the corporation. They compare favorably with the average rents generally paid for the inferior accommodation now provided in cottage houses in Liverpool.

The Northern Pacific's Annual Report.

In view of the large amount of construction work which this company had been and is doing, the following abstract from its annual report for the year ending June 30, 1890, will be of interest. The report shows a generally favorable increase in the business. The main results of operations were as follows, as compared with those of the previous year:

	1888-'89.	1889-'90.
Gross earnings	$19,707,467	$22,610,502
Operating expenses and taxes	12,185,944	13,463,746
Net earnings	$7,521,523	$9,146,928
Per cent. expenses to earnings	60.20	57.89
Gross earnings per mile	$5,687.31	$6,227

The gross earnings from traffic were divided as follows:

Passenger earnings	$5,824,163	$6,167,701
Freight earnings	12,877,837	15,600,319
Mail, express and miscellaneous	1,005 466	842,481
	$19,707,467	$22,610,502
Average haul, freight	304 miles.	307 miles.
Revenue per ton mile	1.43 cts.	1.4 cts.
Earnings per freight train mile	77.1 cts.	81.6 cts.

There was an increase in the number of through passengers, but owing to the short average distance traveled there was a decrease in the revenue from this source of 35,575, or 2%. On the other hand the earnings from the local passenger traffic increased $355,517, or 9.3%. In the local freight traffic the gross earnings increased 14.5%, and the tonnage 20%. The through freight traffic shows an increase in gross earnings of 40%, but owing to a slightly higher rate and an increase in average haul, the tonnage shows but a small increase. Of the total freight earnings, 75.7% came from local traffic, 20.7% from through traffic, and 3.6% from transportation of construction material.

The most important financial transaction during the year was the filing of a consolidated blanket mortgage of $160,000,000, the proceeds to be used in retiring the old first, second and third mortgage bonds, and in constructing branch lines and providing terminal facilities. A contract was also made with the Wisconsin Central R. R. Co., by which the lines of that company between St. Paul, Minn., and Chicago, Ill., were leased for 99 years.

The average mileage operated during the year was 3,585 miles, an increase of 310 miles over the previous year. The increased mileage was made up as follows: Little Falls cut off, 34 miles; Jamestown & Northern extension, 18 miles; Duluth, Crookston & Northern extension, 23 miles; Puget Sound Shore R. R., 23 miles; Rocky Fork & Cook City R. R., 47 miles; Cœur d'Alêne Ry. & Navigation Co., 7 miles; Logan to Butte, 70 miles, and Central Washington Ry., 87 miles. In addition the Northern Pacific & Manitoba R. R., comprising 264 miles, hitherto operated independently, was consolidated with the Northern Pacific R. R., and will hereafter be operated by it.

In regard to the present and future construction the report says:

The extension of the Cœur d'Alêne Ry. & Navigation Co. lines eastward, across Idaho, and the connection at the Idaho boundary with the lines westward from Missoula via Mullan, will give the Northern Pacific direct lines leading both east and west from the important Cœur d'Alêne mining region.

The branch lines now laid in central and southeastern Washington have already proved their value. These will be extended a few miles during the year to reach other territory in the same section.

A few miles of connecting road are necessary in the neighborhood of Lake Washington, near Seattle, to complete the local system of roads now controlled, and to give outlets to new industries.

No portion of the Pacific Northwest is growing in population and wealth faster than southwestern Washington. To reach the important towns of that part of the State about 172 miles of new road have been projected under the general name of the United Railroads of Washington. The lines of this company will probably not be completed before the autumn of 1891, the policy of the company being to make careful progress.

The following is the work now under way or completed since the close of the fiscal year:

Montana.—The line from Missoula to Mullan is progressing favorably; from De Smet about 60 miles have been completed, and the work upon the whole distance to the Summit (the boundary between Idaho and Montana), 107 miles, is well in hand.

A road from Kootenai Station on the main line to Bonner's Ferry, Idaho, and thence to the national boundary, has been chartered. The choice of location was thus secured. The object of the road is to reach the Kootenai mining region.

Surveys are being made to determine the best and most feasible route from some point on the main line to the mines at Castle, Mont.

Washington.—On the Central Washington R. R. the track from Almira to Grand Coulee, 30 miles, is about completed.

The extension of the Green River & Northern from Durham to Snoqualmie, about 18 miles, is progressing, but may not be completed this year.

On the Spokane & Palouse R. R., work upon the 16 miles through and around the Nez Percés Indian reservation has been progressing but slowly.

Work is being vigorously pushed upon the Northern Pacific & Idaho R. R., from Pullman to Moscow, in order to be ready for this season's business. The line of this road to the Nez Percés Reservation and thence to Lewiston and up Tammany Creek, as laid out, comprises about 60 miles of additional track.

The Northern Pacific & Puget Sound R. R. is located from Black River Junction, east of Lake Washington, to a junction with the Seattle, Lake Shore & Eastern at Snoqualmie.

The united railroads of Washington comprise: A line 60 miles from Chehalis to Shoalwater Bay, upon which progress is at present slow; a line from Centralia to Oceosta, about 66 miles, upon which grading and tracklaying are proceeding rapidly, and a line from Lakeview, via Olympia to Black River Junction, about 46 miles, upon which no great delays are looked for, the matter of right of way and terminals at Olympia being satisfactorily settled.

At Tacoma the preliminary work for the shops of the company has been completed, as has also some of the superstructures.

Minnesota.—Since close of fiscal year about 22 additional miles of the Duluth, Crookston & Northern R. R. have been completed, making the entire road 44 miles

from the Duluth & Manitoba R. R. to Carthage, on the Duluth & Winnipeg R. R.

By the passage of the Land Forfeiture Bill by Congress the company loses that portion of its grant lying between Wallula, Wash., and Portland, Ore. The report of the Land Commissioners shows sales of lands amounting to $1,913,846 during the year. The expenditures of the land department, including taxes, were $536,417. The total sales of lands to date are 7,383,272 acres and the amount unsold is 39,441,687 acres.

The Price of Asphalt.

The Committee on Streets and Alleys of the Kansas City Common Council has submitted the following report on an ordinance to fix the maximum price at which contracts for laying asphalt pavements in that city shall be awarded:

We have corresponded with 15 cities, receiving replies from 12. In 7 of these there is no competition, and as a result the price for same ranges from $2.50 to $5 a square yard, the Vulcanite Paving Co. doing the work in Philadelphia at $2.50 without competition. In Washington the price is restricted by law to $2.25. Four companies are in competition in Boston, but most of the work is now being done by CALEB R. AYER at $2.50. We have attempted to obtain from the Western Paving & Supply Co., of Chicago, and the Vulcanite Paving Co., of New York, an expression of a desire to compete with the Barber Asphalt Co., but have signally failed. The former company made reply to our first communication, but no answer has been received to a second letter written them. The Vulcanite Paving Co. was written to twice, but beyond a reply that the first letter was not received, nothing further has been heard.

We believe that asphalt paving can be laid in Kansas City at $2.65, and the company doing the same derive a reasonable profit.

By advice of the city counselor we recommend indefinite postponement of the ordinance No. 6,558 and the adoption of the accompanying substitute resolution.

The resolution provides that $2.65 be the established price for pavement equal to the best laid in Kansas City prior to Jan. 1, 1890, and for the same depth of base and thickness of the wearing surface.

The first proposed ordinance limited the price to $2.50 per square yard and provided a fine of from $500 to $5,000 for the city engineer or members of public improvement committees who awarded an asphalt paving contract at a greater price.

The schedule submitted by the committee contains the following information:

New Orleans pays $3.25 to the Barber Co.; 20 years' maintenance of paving; no competition; 6 miles in use.

Baltimore, $2.50 to the Maryland Paving Co.; 2 years' maintenance; no competition.

Buffalo, $3 to the Barber Co.; 5 and 8 years' maintenance; no competition.

Omaha, a scale of $2.98, $2.68 and $2.48 to the Barber Co.; 5 years' maintenance; no competition.

St. Louis, $3 to the Barber Co.; 9 years' maintenance at 50 cents a year for each square of 100 yds.; no competition.

Chicago, $3 to the Barber Co. and the Western Paving & Supply Co.; 5 years' maintenance; 23 miles of asphalt.

Washington, $2 and $2.25 to the Barber Co. and the Cranford Paving Co.; 5 years' maintenance.

Topeka, $2.80 to the Barber Co.; 5 years' maintenance; no competition; 193,000 sq. yds. in use.

Boston, $2.47 to $3.50 to the Barber Co.; $3, $2.5, and from $2.25 to $2.70 to other companies; 5 years' maintenance.

Philadelphia, $2.50 to the Vulcanite Paving Co.; 3 years' maintenance.

New York, $3.33 to $4, and $3.50 to $5, on a 5 and 15 years' maintenance, respectively.

The Proposed Birmingham and Liverpool Ship Canal.

The Birmingham and Liverpool Ship Canal projectors, encouraged by the success of the Manchester Canal, are pushing their project. It would connect the Midlands with the seacoast, and doubtless immensely facilitate the export trade of Staffordshire. It is an engineering project of considerable importance. The line from Birmingham to the junction with the Weaver would be 63¾ miles long. The Weaver navigation now extends 20 miles to the Mersey, which it strikes at Weston Point, 15 miles from Liverpool.

The proposed canal would be 72 ft. in minimum width, with accommodations for sea-going vessels of 300 tons and barges of 400 tons. The ground rises from 453 ft. above sea-level, northwest of Birmingham, to 460 ft. at Trentham, and falls to 54 ft. at Winford. In a distance of 7 miles on the Trent and Mersey Canal there are no fewer than 25 locks. In the new canal the change of level would be made by 17 powerful hydraulic lifts of the La Louviere type at a speed of 20 ft. per minute and little waste of water.

The present Weaver locks will carry four vessels of 250 tons at once, being 220 ft. long, 42 ft. wide and 15 ft. deep, and where the Weaver joins the Mersey there is 10 ft. of water at low tide, more than sufficient for the intended navigation.

The total estimated cost is $25,000,000, or $15,000,000 for the canal and engineering works, and the remainder for land, etc.

The International Engineering Convention.

(*Continued from page* 346.)

In the return down the Monongahela River, the boat was, as already noted, very crowded. This fact was made especially manifest when, just after leaving Homestead, there was a unanimous rush for the table where the lunch was spread. When upward of 1,000 people make a united attempt to reach one side of a table 40 ft. long, some of the most porcine traits in human nature are certain to appear. Moreover, those in whom these traits are best developed are apt to secure the lion's share. In this case those who struggled for food and drink secured something, while not a few who waited for the crowd to become penetrable about the table where the luncheon was piled had to content themselves with the anticipation of next morning's breakfast.

But when the boat reached Hay's Station such minor inconveniences as an empty stomach were forgotten in witnessing the magnificent natural gas display made by the Philadelphia company. A stand-pipe on a projecting pier threw out a great jet of flame, 30 ft. in length, which was changed to red and to green alternately by injecting pyrotechnic chemicals into the pipe. By and by this flame was cut down, and just as the watching eyes had grown accustomed to the intense darkness which succeeded, a great wall of flame burst from four tall stand-pipes near the bank of the river, lighting up the whole river and the wooded bluffs on either side. The pipes were nearly 40 ft. in height, and the towering flame which raged above them shot out fiery tongues to a height of 150 ft. above the ground.

By and by this, too, died away, and only a little flame on the pier relieved the intense darkness. By its light the surface of the river a hundred feet from the shore was seen to be boiling as if a young and active geyser had just been born there. The initiated knew that a gas pipe running out on the river bottom was sending up a great stream of gas; but few others of the party even noticed the disturbance of the water. Soon a little launch stole up toward the geyser and sent some balls from a roman candle toward it. In an instant a great mass of flame flashed up from the surface of the water and burned fiercely over a space 30 ft. or more in diameter. A cheer arose from the crowd on the boat. Pittsburg had performed the hitherto proverbially impossible feat of setting the river on fire.

After a half hour or more of this novel pyrotechnic display the *Mayflower* steamed on down the river. Another natural gas display was made by the Manufacturers' Co. a few miles further down, and for miles along the river, as the boat neared Pittsburg, the furnaces, steel works, natural gas pipes and electric street lights made a pyrotechnic display the more magnificent because of the tale of industry it told.

As the boat rounded to the bank at the end of the journey, the tower of Pittsburg's magnificent court house came into view, showing on its river face a beautiful shield in colored electric lights; the band played the national airs of England, Germany and America, and everybody went home very tired, but for the most part well pleased with the afternoon's pleasure.

SATURDAY, OCTOBER 11.

The principal excursion of this day was up the Allegheny Valley to the works of the Pittsburg Plate Glass Co. at Tarentum, stopping on the way at the Isabella Furnaces at Etna, where a new furnace not yet in blast, and in many respects a model furnace, was examined with much interest. Making plate glass is an industry with which many members of the party were not familiar, and the process was followed from the casting table to the annealing ovens, and thence through the various stages of grinding and polishing till the finished sheets were reached. Those who imagine that the manufacture of plate glass in this country is still an infant industry may be interested to know that the three works of the Pittsburg Plate Glass Co. have a combined capacity of 6,000,000 sq. ft. per annum. The total number of employés is 2,450.

From Tarentum the train took the party up the valley several miles and then returned on the other side of the river to Pittsburg, stopping on the way at the pumping station of the Pittsburg Water-Works. The two duplex fly-wheel pumping engines here have steam cylinders 5 ft. × 14 ft., and are of quite novel design.

The next stop was made at Fifty-second St., where the Lucy furnace of Carnegie, Phipps & Co., the Crescent Steel Works and the Keystone Bridge Works were visited. At the latter place the visitors saw a pneumatic riveter heading rivets at the rate of 29 per minute. The most important work now in progress in the shops is the structure of the Chicago Elevated Railroad.

From this point the visitors were taken to the Carbon Iron Co.'s works. This process of making iron direct from the ore was described in ENGINEERING NEWS of March 24 and April 14, 1888. The company's plant now comprises four open-hearth furnances and three trains of rolls, and, the output is about 40,000 tons per annum of high grade structural steel. The last works visited by the party were the aluminum producing works of the Pittsburg Reduction Co.; and this was generally declared to be the most entire novelty the visitors had yet seen. The metal is extracted from aluminum by electrolysis. The electric current is generated by four dynamos, two 1,000 amperes, 25 volts, Westinghouse, and two 2,500 amperes, 50 volts. The output of the works is now 375 lbs. per day. Plans are now being prepared for a new plant which will have a total output of five tons per day.

Another excursion which was enjoyed by a small party was to the Connellsville coke region, and those who did not go on either of the above excursions enjoyed themselves in independent tours about the city.

Most of the party were kept indoors by a pouring rain. At 6 P. M. the visitors bade good-by to Pittsburg and started on their journey westward.

CHICAGO.

The Chicago local committee had started with the intention of eclipsing in the munificence of their hospitality all that New York, Philadelphia and Pittsburg had done. The general verdict of the party was that they succeeded. Before the visitors reached Pittsburg delegates from the Chicago reception committee had met the party and assigned them quarters at the Chicago hotels. The process of getting settled, therefore, took much less time than usual.

At 10.30 A. M. those who could crowd in assembled at the Palmer House parlors, where Mayor DEWITT C. CREGIER welcomed the visitors and announced that the Board of Aldermen of Chicago had presented the visitors with "the freedom of the city." The record of this official welcome was inscribed in a morocco-bound volume which was presented to the President of the Iron and Steel Institute by the Mayor.

When these official greetings were over the reception committee took the visitors in carriages out Michigan Ave. to the Washington Park Club House, where an excellent luncheon was spread. A season of speechmaking followed, in which the Columbian Exposition of 1893 and the city of Chicago were lauded to the skies, while the McKinley bill was dubbed the skeleton at the feast.

At 3 P. M. a special train of 15 cars took the party back—not to Chicago, but to the business center of Chicago, as Mayor CREGIER carefully explained. The fire department and police patrol gave an exhibition of their value to the visitors on the Lake front, the most interesting features of which was the unanimous manner in which the crowd dodged the streams from the hose.

The great event of the day and of the whole Chi-

cago visit was the reception at the Auditorium Hotel in the evening. The parlors of the hotel were given up to the reception, and all the boxes and 200 other seats in the Auditorium theatre were reserved for the visitors, who listened to a concert by the Eduard Strauss orchestra. Afterward a large number went down to the stage, where, by the courtesy of Mrs. Ferd. W. Peck, the hydraulic machinery of the stage were exhibited. Refreshments were served in the magnificent banquet hall of the Auditorium, which is without doubt the finest in America, and was used for the first time on that evening. The visitors were unanimous in their praise of both the banquet hall and the auditorium. Chicago has ample reason to be proud of them both.

Tuesday was devoted to a visit to the Illinois Steel Works, the Fowler Steel Car Wheel Works and the Pullman Car Co.'s shops, of which a fuller account will begin next week. Then the excursionists separated, one train load going north to the iron and copper mines of Michigan and the remainder, in three trains, going to the mineral districts of the South. An account of the latter party's experience will be given in our next issue.

THE BRITISH AND GERMAN METALLURGISTS IN THE WEST AND SOUTH.

On the whole, the visit to the South Chicago works of the Illinois Steel Co. was one of the most interesting of any made by the party. The works as now operated take the molten metal from the blast furnace and charge it directly to the Bessemer converter. The ingots, while still red hot, are placed in gas-fired soaking pits at the head of the blooming mill. This is a 40-in. three-high mill, driven by a Porter-Allen engine. At the rear of the blooming mill is the shear which cuts the rolled ingot into two 3-rail blooms. The head of the rail mill is in line with and close to the rear of the blooming mill, and the blooms pass directly to it. Thus it is seen that the small amount of gas used in the soaking pit is the only fuel used for heating the metal from the blast furnace to the finished rail. This rail mill has just been started to take the place of a 28-in. two-high reversing mill erected in 1882.

Extensive improvements are now in progress which will make the steel making plant at these South Chicago works the largest in the country. A new plant of 4 blast furnaces is approaching completion, and it is expected to work the output of both the four old furnaces and the four new ones direct by the present Bessemer plant, which is being strengthened by the addition of a new blowing engine and boilers. When the new furnaces are in blast, the melted metal from all the blast furnaces will be put through a mixer before passing to the Bessemer converter, as is done at the Edgar Thomson works. Besides the above plant for the manufacture of rails, a large open-hearth steel plant and plate mill are under way.

The ore used by the company comes almost entirely by vessel from the Lake Superior district. A large plant for unloading vessels has just been erected for the company by the Brown Hoisting and Conveying Co., of Cleveland, O. This plant excited great interest among the visitors. The ore buckets are raised from the hatches, run inward along an overhead truss, and dumped automatically on the stock piles at any desired point.

The Illinois Steel Co. is now almost, if not quite, the largest producer of iron and steel in the world. When the additions now under way are completed the company will have 19 blast furnaces, with a total annual capacity of 1,200,000 tons, 4 Bessemer plants with an annual capacity of 1,100,000 tons, and its possible total output will be 850,000 tons of steel rails, 100,000 tons of steel billets, 60,000 tons of rods, 60,000 tons of plates, 80,000 tons of structural steel and 75,000 tons of merchant steel, or 1,225,000 tons in all of salable product. The company is capitalized at $27,000,000, and its various works give employment to about 10,000 men.

Compared with this great plant the works next visited, the small factory of the Fowler Steel Car Wheel Co., was of little importance, but the process was interesting from its novelty. As has already been described in Engineering News, a steel casting is made of the shape of a car wheel and from ¼ to ¾ in. larger in diameter than the finished wheel is intended to be. This is placed in a mill and five rolls of a shape to just fit the tread and flange are brought against the circumference of the wheel and set revolving. At the same time they are gradually forced toward the center, thus compressing the whole wheel and especially consolidating and toughening the tread and flange. When finished the wheel is ⅛ to ¾ in. less in diameter than at the start. It is then placed in a soaking pit for annealing, after which it is ready for use. These wheels are claimed to show remarkable toughness under a drop test and some of the wheels made in the experimental works have run over 200,000 miles with a wear of less than 1-16 in. The cost of the wheels is a little more than half that of a steel-tired wheel of the same diameter.

After a short stay at these works the party was taken to Pullman. Here a lunch was served in the Arcade building, and the visitors spent the remainder of the afternoon looking through the company's shops. The output of all classes of cars is now about 58 per month, of which about one-fourth are sleepers; but extensions now under way will enable the shops to turn out 25 to 30 sleeping and parlor cars per month.

Among the cars ready for shipment which the visitors inspected was a beautiful compartment car, having the aisle along one side. This especially pleased the Englishmen. The new "pressed plush" finish is being largely used for trimming, with most pleasing results. For a year and a half brake shoes have been applied to all wheels of six-wheeled trucks, a most commendable improvement over former practice.

The visitors were shown some intricate pieces of wood carving which, as every one knows, is extensively used in the finish of Pullman cars, and were told that the work was done by machinery. Immediately there was a unanimous desire to see the machine, which was found to consist merely of three revolving chisels mounted in a hinged frame and capable of being twisted or turned in any direction, the three however keeping their axes always parallel and always at the same distance apart. The center chisel is a blank, and a finished carving of the pattern it is desired to reproduce is placed beneath it. Under each of the other chisels is placed one of the wood blocks to be carved, and the workman guides the chisel over the surface, being aided by the blank center tool passing over the face of the pattern. If the visitors found the machine less of a mechanical wonder than they had expected, their respect for the finished carvings as true works of art was considerably increased. It should be explained that after the machine work is done upon the carving it is "under cut" and finished with hand tools in the usual manner.

Apropos of wood carving, an elegant private car for Mr. Austin Corbin, now nearing completion at the shops, is decorated with carvings and carved panellings in a most elaborate manner. The car is 70 ft. long over end sills.

Perhaps the place about the works where the visitors remained longest was at the spacious room where the great Corliss engine, which won the admiration of so many thousands at the Centennial Exposition, performs its daily routine of work. It still drives nearly all the machinery of the shops with excellent economy and reliability, deserving the handsome room and surroundings in which its owners have placed it, because of its excellent service, as well as for its widespread fame.

Taken all in all, the visitors were perhaps better pleased with Chicago than with any city they had yet visited. They praised the pavements, which were indeed a relief after Philadelphia and Pittsburg, to say nothing of New York. The pleasant lunch at the Washington Paris Club, the evening of music and pleasure at the Auditorium, with a judiciously small amount of time spent in examining industrial works made a mixture which the strangers found most agreeable, and quite a number remained for some days longer in the city. The great bulk of the party, however, divided into two sections, one going north to the Lake Superior iron and copper district, and the other by the way of the Chicago, St. Louis & Pittsburg and Louisville & Nashville Railways to the Southern iron regions.

Legal Decisions of Interest to Engineers.

Rosendale Cement Trade-Mark. - The defendants manufactured and sold cement which they denominated as Anchor Rosendale Cement, though made in Lehigh County, Pennsylvania, from stone quarried there. The complainants manufactured cement in the town of Rosendale, N. Y., where there are extensive quarries of cement rock, which are worked by some 15 or 20 different parties, some of these Rosendale quarries having been worked for over half a century; but the complainants commenced their operations about 1874. The cement made in Rosendale and its vicinity has always been called Rosendale; and the complainants contended that the term had acquired a generic signification applicable to the hydraulic manufactured at Rosendale and vicinity, and inhering in the marketable quality of the cements manufactured by the complainants and others. The bill was filed for the purpose of enjoining the defendants from using the word "Rosendale" in describing their cement, and to obtain damages, and an account of profits for such use. If a person seeks to restrain others from using a particular trade-mark, trade-name, or style of goods, he must show that he has an exclusive ownership or property therein. To show that he has a mere right, in common with others, to use it is insufficient. The Bill must be dismissed. (New York & Rosendale Cement Co. v. Coplay Cement Co., U. S. Circuit Court, E. Dist. of Pa. Decision filed Oct. 9, 1890.)

Limitation of Liability for Negligence.—A railroad company will not be permitted to limit in any way by contract its liability for personal injuries sustained by others through the negligent operation of its trains by its servants. This liability is imposed by law and cannot be rendered nugatory by contract.—(Johnson's Adm'x v. Richmond, Supreme Court of Appeals of Virginia, 11 S. W. Rep., 829.)

Lease of Railway Right of Way for Lumber Yard.—All that a railroad company gets by condemnation is the right to use the land taken for railroad purposes, and one who establishes a lumber yard on such land under an arrangement with the company, subjects himself to the payment of rent to the owner from whom the land was taken, as the railroad company neither has the right to make such use of the land or permit others to. (Lyon v. McDonal, Supreme Court of Texas, 14 S. W. Rep., 260.)

Recovery of Value of Services Performed.—Where one performs services for another, and for any reason except voluntary abandonment of his contract fails to comply fully with the terms of the agreement, if the portion of the work which he does is of benefit and value to the one for whom they are done, he may recover their reasonable worth and value less such damage as may have been sustained by reason of the breach of the contract. (Gove v. Island City Mercantile Milling Co., Supreme Court of Oregon, 24 Pac. Rep., 521.)

Acceptance of Road as Highway.—When a railroad company so constructs and maintains a crossing over a traveled road as to indicate that it regards it as a highway, it will not be heard after years of such recognition, to deny that the road had been properly dedicated, and affirms that in fact it is not a public highway. (St. Paul, M. & M. Ry. Co. v. Minneapolis, Supreme Court of Minnesota, 46 N. W. Rep., 324.)

PERSONALS.

Mr. Wm. P. Rounds has been appointed Superintendent of Water-Works at La Salle, Ill.

Mr. J. F. Foley has been appointed Assistant Superintendent of the Baltimore & Ohio R. R., with headquarters at Newark, O.

D. G. Barnard, Superintendent of the Haddonfield, N. J., Water-Works, died recently from injuries received by being thrown from a wagon.

Mr. C. C. Hill, Superintendent of the West Troy and Green Island Water Companies, has resigned. He is now in the South in the interest of the Eddy Valve Co., of Waterford, N. Y.

Mr. Ira M. McCormick has resigned his position as Trainmaster on the West Shore R. R. to accept a like position on the Pittsburg & Lake Erie R. R., with headquarters at Pittsburg.

Mr. F. S. Balcom has resigned his position on the engineering staff of the Illinois Central R. R. in order to become Engineer of the Cairo Division of the Cleveland, Cincinnati, Chicago & St. Louis R. R., with headquarters at Indianapolis.

Mr. F. W. Patterson has been appointed Engineer of Maintenance of Way of the Pittsburg Division of the Baltimore & Ohio R. R., replacing Mr. W. T. Manning, who has been appointed Chief Engineer of the Staten Island R. R.

Mr. Ernest Adam, for the last 5 years City Surveyor of Newark, N. J., has resigned his position, but will continue in the engineering profession as an associate with Mr. David Young. Mr. Adam has been connected with the Newark office for 25 years, for the first 20 years as assistant surveyor.

Dr. John Farnham Boynton died at Syracuse, N. Y., on Oct. 20, aged about 80 years. Dr. Boynton among about 30 other useful inventions, conceived the idea of extinguishing fire by the rapid generation of carbonic acid gas, and sold for $10,000 the patent for the machine since well known as the Babcock fire extinguisher.

Messrs. J. Herbert Shedd, City Engineer of Providence, R. I.; J. P. Davis, of New York, and E. W. Bowditch, of Boston, have been appointed a commission to report on the proper methods of conducting the engineering department of Boston, Mass. The appointment was made by the citizens' committee and approved by Mayor Hart.

Mr. J. T. Harahan has been chosen Second Vice-President of the Illinois Central R. R. He has been acting as General Manager of the Louisville, New Orleans & Texas Ry., and was formerly General Manager of the Louisville & Nashville, and afterward for several years

General Manager of the Chesapeake & Ohio, and Assist. General Manager of the Lake Shore & Michigan Southern lines. He has been in active railroad service for more than 25 years, and in the whole time has been connected with Southern railroads.

Sir RICHARD FRANCIS BURTON, the famous African explorer, died on Oct. 20 at Trieste. Sir RICHARD was born in 1821 in Hertfordshire, England, graduated at Oxford, and in 1842 joined the East Indian service. He commenced his explorations in the Neilgherry Hills, in India, and then acquired a wide acquaintance with Eastern languages. In 1851 he visited Mecca and Medina as a wandering dervish and wrote up his travels. He later visited East Africa, served in the Crimean war, and in 1856, with Capt. SPEKE, penetrated to the lake regions of Central Africa and discovered Lake Tanganyika. Since 1872 he has been British Consul at Trieste. He published in all over fifty books of travels in Africa, the United States, Brazil, Palestine, Arabia, India, etc.

Mr. ALFRED BULT MULLETT, one time supervising architect of the U. S. Treasury Department, committed suicide by shooting in Washington, D. C., on Oct. 20. Mr. MULLETT was born in England in 1834, and came to this country early in life, and settled in Glendale, O., where he commenced the study of his profession with ISAIAH ROGERS, a leading architect at the time. He was a partner of Mr. ROGERS until the outbreak of the Civil War. During the war Mr. MULLETT was a clerk in the office of the supervising architect at Washington, and through the influence of his friend, Hon. SALMON P. CHASE, he was promoted until he was at the head of the office. He was supervising architect for about 15 years, and resigned under Secretary BRISTOW. He designed the War, Navy, and State Department buildings, and the U. S. public buildings at Portland, Me., New York, St. Louis, Cincinnati, Philadelphia, and Chicago, among other work. He was accused of connection with a Maine granite ring, but his friends never doubted his integrity, and he left the office poor. He practiced extensively as an architect after leaving the U. S. service, and was a member of the Board of Public Works of Washington, D. C.

NEW PUBLICATIONS.

—*Der Tunnelbau.* Ein Lehrbuch; von Prof. CARL DOLEZALEK. Zweite Lieferung Hannover, Helwingsche Buch handlung; 8vo, pp. 96, 5 folding plates.

The second installment of this text book opens with a description of various drill carriages, which, however, is almost entirely wanting as regards American examples, followed by a partly theoretical investigation of the mechanical work done by the compressed air or steam in percussion drills. The chapter on "Labor" is interesting as giving the European practice in handling workmen. From Professor DOLEZALEK'S figures, it appears that in the headings of the Gotthard and Arlberg tunnels, 16 and 14 men were respectively employed in tending 6 Ferroux drills mounted on carriages, moved ahead automatically. In the Monte Ceneri and Peloritana (Sicily) tunnels, 8 or 9 men were detailed to each set of 4 MacKean-Seguin drills mounted on a single carriage with an automatic forward motion. At the Krähberg (Odenwald) and Brandleite (Thüringerwald) tunnels with 3 or 4 Frölich drills mounted on columns held in position by hydraulic pressure, 7 and 9 men were required respectively. In the Vosburg (Pa.) tunnel, 8 men were required to handle the 4 Rand and Ingersoll drills, which were mounted on screw columns. In the Roth tunnel, in Westphalia, 5 men were necessary for managing the 2 Sachs drills mounted on an automatically advanced carriage. At the Milseburg tunnel in the Rhöngebirge, 4 men were sufficient to operate 2 Jäger drills mounted on hydraulic columns.

Probably the most interesting portion of the work to American readers yet issued is the description of rotary drills and their use. The Brandt system is well described; the No. 2 Brandt drill, now almost exclusively used where rotary machines are employed, is illustrated and explained. The new rotary machine, the Jarolimek, is also illustrated. The description of the use of these drills seems to be complete and concise, and the short tables of progress in different kinds of rock are valuable, but are not detailed enough. A description of the various classes of explosives used in tunneling closes this second part of the work, which contains much more information on American practice than the first part, noticed in ENGINEERING NEWS of Sept. 16.

—*The Thames River Bridge and Approaches, at New London, Conn.*—Report to the General Manager N. Y., Prov. & Boston R. R. on its construction. By ALFRED P. BOLLER, Chief Engineer, 1890. Oblong folio, illustrated. Published by the author and for sale at this office. Price $5.

This is a full report by the Chief Engineer, for the use and information of other engineers as well as for the officials of the New York, Providence & Boston R. R. For more than 20 years the depth of water and mud at this crossing deterred engineers from attempting to found a bridge at this point, though the project had been broached and more than once abandoned during the period preceding 1882 as being beyond the engineering and financial resources of the day. In 1882 a bill was finally passed authorizing the present "Shore Line" Ry. to bridge the Thames at New London; but legal difficulties blocked the way until 1888, when Mr. BOLLER was directed to commence his surveys, and to make plans for the bridge and approaches. The construction of the bridge was awarded to the Union Bridge Co., of New York, April 6, 1888, and it was officially opened to traffic on Oct. 10, 1889.

The total length of new work required by the bridge was 5.13 miles. The chief difficulty in location and construction lay in the piers and abutments and their foundations, the adopted plan calling for a draw-span of 503 ft. flanked on either side by spans of 310 ft. and 150 ft. each. Careful soundings made at the site of the main foundations only reached rock and boulders at depths of 130, 100 and 120 ft. below mean low water, and the material overlying this rock was from 60 to 75 ft. deep. Pneumatic foundations were out of the question and the ingenious methods adopted and carried out by Mr. BOLLER are fully described and illustrated in this report with an engineering minuteness that makes them of great professional value.

The superstructure, with its great swing draw-span of 503 ft., is treated in a similarly careful manner, and is made plain in all its details of design and erection by concise description and complete drawings, with dimensions and sections. As we have before mentioned in this journal, the bridge is not only one of the latest and best examples of American steel bridge design, but its treatment is artistic in general form and detail, and the result proves conclusively that even so utilitarian an object as a railway bridge can be made a pleasing object to the eye without practical increase in cost. The bridge proper only cost $658,489, though the entire cost of land, approaches and general account swelled the final cost to $1,293,939. In appendices are given the official tests of the bridge, the full specifications of foundations and superstructure, the weight of metal in the truss spans, full-sized eye-bar tests, and the various other finished material tests. The illustrations are from photographs taken during and after erection, and the various detail sheets of foundations and superstructure are fac similes of Mr. BOLLER'S own plans, these latter including the turntable and gearing and end-locking gear. Taken altogether, it is a model report, and proves how useful a complete record of a difficult and important piece of work can be made to the engineering profession when the engineer in charge goes conscientiously to work. The final regret is that reports of this kind are too rarely issued by the executive officer, who is alone able to fully detail the true history, and that it is still more rare to find corporations willing to publish such reports when made.

—*The Resources of the Black Hills and Big Horn Country, Wyoming.* By H. M. CHANCE, Mining Engineer and Geologist. Reprint of a paper read before the Am. Inst. Mining Engineers. 1890. Address 418 Drexel Building, Philadelphia, Pa.

This is a report apparently originally made to the officers of the Chicago, Burlington & Quincy R. R. Co., and was intended to show the resources of the country west of the Black Hills and in the foot hills of the Big Horn Mountains in Northeast Wyoming. Copper, iron and tin were found widely scattered and in promising abundance. The gold deposits have already been fully described by Prof. F. B. Carpenter, who also states that cement and fire-clay exist in great quantities. Railroads, large capital and well-planned mills and reasonably low-priced labor will make the working of tin possible and profitable. Oil fields are being now developed, and they guarantee the presence of natural gas. Newcastle coal is now mined on a large scale, and will furnish excellent coke.

—*Report of a Commission of Engineers to inquire into the Causes of the Floods at Montreal.* THOS. C. KEEFER, H. F. PERLEY, JOHN KENNEDY, P. W. ST. GEORGE, Commissioners. Published by City of Montreal, 8 vo. pp. 76.

This learned and careful report on an extremely important local question, while a model of its kind will hardly bear abstracting, except as to its conclusion, which is that, bad as are the floods, there is no radical cure for them, but on the contrary they may be expected to grow higher rather than lower; and hence that the only defense against them is the system of dyking, which has already been begun. It involves quite a serious expense to Montreal, but after all, a large part of it has been already incurred and the rest of the work can be done gradually. To any one interested in the question of ice in northern rivers this report is well worth study.

—*Third Annual Report of the City Surveyor and Supervisor of Streets and Highways of Camden, N. J., for* 1889. City Surveyor, L. E. FARNHAM. Paper, 8vo, pp. 48.

This report is prefaced with a brief outline of some of the principal engineering and other features of the city. Table 7 of the report describes in detail every sewer in the city, giving, also the cost and the contractor. The report calls attention to the fact that in constructing the first part of the present sewerage system the main attempt was to drain the ground, which was very wet, and to provide for the removal of storm water. The inverts were laid loose, with spaces between the bricks. These sewers have since become fouled and demand rebuilding.

—*Annual Report of the Minister of Railways and Canals* of Canada. For the Fiscal Year ending June 30, 1890. Pub. Doc., 8vo, pp. 333.

This report, while very voluminous, is largely one of minute detail. It relates chiefly to the lines of railways and canals owned and operated by the government. It gives the details of 184 different subsidies to as many different lines, and of 15 different land subsidies. A convenient series of system maps (Government, Canadian Pacific, Grand Trunk and "Other") accompanies the report. The department expended last year on railways and canals, $8,806,841 ($4,939,529 for construction and repairs) and received $3,543,823:

	Expenditures.	Receipts.	Loss.
Railways	$7,114,343	$3,167,543	$345,521
Canals	1,692,498	376.280	1,316,218
Total	$8,806 841	$3,543,823	$1,661,739

[$3,601,279 charged to railway expenditures went in part to subsidies and new lines, and in part only to additions to the old lines.]

The total amount expended on the Welland Canal alone to date is $23,787,950, and on all the government railways and canals something like $100,000,000 if we recall correctly the figures for this total are missing from the report) so that in a purely financial sense the canals especially are not a very brilliant commercial success. The loss shown for the railways is not nearly the difference between the expenditures and the receipts, a large part of the expenditure being for subsidies and extensions. On the other hand considerable sums for construction were expended on the old government railways, which were not included in the working expenses from which the loss was computed. The actual loss, had all the unavoidable construction expenses been charged against revenue, would have been larger.

—*Twenty-first Annual Report of the Salem (Mass.) Water Board.* December, 1889. Paper, 8vo, pp. 28.

The pumping statistics in this report are quite complete, but the cost per gallon pumped is not given in the table, and must be calculated by those interested. The average working duty of the engines (two 5,000,000-gall. Worthington) for the year was 60,181,440 ft. lbs., but it is stated that the coal used was poor. The rainfall is given by months for the past three years. An interesting table sets forth the leaks in the distribution pipes in 1889, giving the size of the pipe, when and how repaired and the cause of the leak. Of 34 leaks in 1889, in about 50 miles of mains, in 17 cases the pipe burst, in 12 the leak was at a joint, two were caused by pick holes, in one case a plug blew off and the causes of two breaks are not stated.

—*Eighteenth Annual Report of the Water Board of Lynn, Mass, for* 1889. Paper, 8vo, pp. 64, and two folding sheets.

This report contains an unusual amount of valuable matter. First there may be mentioned a brief description of the additional storage basins built during the year. There is a statement of the number and character of the buildings supplied with water in the past year and the number and character of the various fixtures supplied. Another statement gives the class of premises to which meters are attached, with the number and size of the latter. There are, in addition, quite full statistics relating to the various features of the works and extended meteorological records. A diagram shows the average monthly consumption of water and the monthly rainfall for the past 10 years, and a topographical map shows the sources of supply, the pumping station, the connection between the two and the surrounding country.

—*Report on Sewerage and Drainage of Williamsport, Pa.* By CARROLL PH. BASSETT, C. E. Aug. 15, 1890. Pamph., 8vo, pp. 31.

A somewhat extended exhibit of the local conditions, and needs, as regards a sewerage system, is set forth in the report. A gravity system, on the separate plan, but with some slight modifications, is recommended. The storm water system would be in four sections, and is estimated to cost $409,000. The sanitary or house system would be in six, and eventually in seven, sections or districts, and is estimated to cost, excluding the seventh district, $366,000. It is recommended that work be commenced as soon as possible on certain streets for the sanitary system, the cost of this work being estimated at $91,000. Of the storm water system a part of the Grafis Run section should be constructed at once, the estimated cost being $112,000. It is designed to straighten and confine Grafis Run, which now has a tortuous course through the city, and is subject to overflows in times of heavy rains.

—*Bombay Municipality Water-Works.* Pawal Project. By S. TOMLINSON. Bombay, 1889. Pamph., pp. 42, and map and colored diagram.

This report deals with the problem of an increased water supply for Bombay, India, as proposed to be taken from a large impounding reservoir. The scheme involves the construction of masonry dam, a pumping station with engines and boilers and new mains. The Worthington pumping engines are recommended, and statistics to show their extensive use in this country are taken from

the *Manual of American Water-Works*. The diagram shows the rainfall from 1861 to 1889, inclusive, in the Vehar Lake Valley, from which the present supply is drawn. In the diagram a horizontal line represents the average rainfall and rectangles above and below the line show years of maximum and minimum rainfall. An elaborate study of rainfall at Vehar and Tulsi Lakes, and the corresponding effects upon the available water supply is presented by tables. A table of maximum weekly rainfall shows that in 1861, for the week ending Aug. 17, 27½ ins. of rain fell, and in five later years over 25 ins fell in one week. In all but two of the 29 years included in the table the maximum weekly rainfall was over 11 ins. The exceptions were 1871, 5.78 ins., 1881, 9.60 ins. The average of the maximum weekly rainfall for the 29 years 1861 to 1889 was 18.35 ins.

—*Report of the City Surveyor of Montreal] for* 1889. PERCIVAL W. ST. GEORGE, City Surveyor. Paper, 8vo , pp. 253, and three folding sheets of diagrams and tables.

This is a very detailed report of the work done under the direction of the City Surveyor during 1889, on sewers, streets and sidewalks. In addition, each sewer is described as regards location, length, size and material, and references are made to the office records giving further details. A summary shows that of 128.25 miles of sewers at the close of 1889, 116.14 miles, or 90.55%, were of brick, circular, oval and horse-shoe, in section, and from 1 to 8 ft. in diameter. Of the remainder, 2.25% are of wood, 4.95% of 12, 15 and 18-in. tile pipe, and 2.05% of stone or arched brick.

Tables, supplemented by a diagram, present a census of several days travel on certain paved streets. The width of the street, kind of paving, date put down and present condition were noted, and the number, character and weight of the passing teams. The above named diagram, on a smaller scale, is presented on another sheet, together with similar diagrams for Cincinnati and St. Paul. The diagrams merely show by rectangles placed vertically and hatched to indicate the character of the pavement, the tons of travel per day per foot of width of street, on various streets. The censuses in Cincinnati and St. Paul were taken by the Warren-Scharf Asphalt Paving Co.

Diagrams and tables present the results of several dry tests of cement for periods of 7, 14, 21 and 28 days. We shall say more of these in a future issue.

—*Report of* JAMES D. SCHUYLER, *Consulting Engineer, on the Pueblo (Col.) Gravity Water Co.* September, 1890. Pamph., 8vo., pp. 16, several illustrations and map.

This report discusses a proposed gravity system of water-works for Pueblo, the water to be secured by gathering pipes from the underground flow of Fountaine que Bouille. The project includes a long supply-conduit and a reservoir. Some features of the plan are quite novel, and will be described in a future issue.

—*Annual Reports received.* Reports of City Engineer for Lawrence and Newton, Mass., Columbus, O., St. Joseph, Mo. Water-works reports for Bangor, Me., Concord, N. H., Boston, Wellesley and Weymouth, Mass. Sewer Commissioners for New London, Conn. General City Reports for Arlington, North Adams, Peabody, Rockland, and Westborough, Mass., and Williamsport, Pa.

—*Transactions of the Denver Society of Civil Engineers and Architects, January-June*, 1890. 8vo, pp. 83.

This issue contains a number of papers on irrigation and irrigation works, making it of somewhat special interest to those concerned in such works. For a "Vol. 1" issue it is very creditable to this young society.

—*Egleston's Metallurgy*, Vol. II., on gold and mercury, is announced for immediate publication by John Wiley & Sons, 53 E. Tenth St., New York. The price is $7.50.

TRADE PUBLICATIONS.

—*The Westinghouse Automatic Brake Catalogue.* Westinghouse Air Brake Co., Pittsburg, Pa. Small 4to, pp. 67.

—*The Westinghouse Air Brake Co. Instruction Book.* The Quick Action Automatic Brake. 12mo. tucks, pp. 63.

—*A Chapter of Don'ts.* Pamph. pp. 8.

In these three publications we have the latest successor to the original Westinghouse Catalogue, and very interesting and gratifying publications they are. It is no small satisfaction to feel that in the great question of air brakes the modern plant has become, not only as good as could be reasonably desired, but as good as seems to be even theoretically practicable; and that practice in regard to them has now become practically uniform throughout the continent, and practically universal on all kinds of railway vehicles.

The new catalogue is a somewhat smaller affair than the old one, being designed chiefly for convenience in ordering brakes. Nevertheless, the illustrations are even fuller than in the old catalogue, and show the newest quick action plant fully. The several brake schedules, as now revised, stand as follows:

A¹. Locomotive equipment complete, including driver brake	$275
B¹. Tender equipment	60
C¹. Passenger car complete	100
H¹. Freight car, complete	45
J. Train signal plant for locomotive and tender	30
K. Train signal plant, for passenger car	15
L. Material to change loco. and tender from old automatic to quick action brake (gross) $10 rebate allowed for old material displaced	50
M. Material for passenger car (gross, $30 rebate allowed)	45
N. Schedules L and J combined	80
O. Schedules M and K combined	60
P. Special plant to brake all wheels of 6-wheel trucks	120
X¹. Materials to change a passenger car from the old straight air to the new quick action brake	80

The new catalogue does not pretend to give any explanation of the plant, which is explained in the Instruction Book. This book contains 4 large folding paltes, and, in addition, cards with movable transparent arms to illustrate the functions of the engineer's brake and equalizing discharge valve.

The little "Chapter of Don'ts" is a capital idea, admirably carried out, giving in colloquial and popular form, which will hold the attention of every trainman, the essential facts about the management of the brakes. We reprint about half of these "Don'ts' as giving concisely some facts as to the brakes which will be generally interesting.

Don't think that the present improvement in the Westinghouse Automatic Brake Apparatus isn't necessary, and that the old automatic was good enough. It wasn't, and we'll vouch for it. Some day you'll agree with us just as you did after a season when the old automatic took the place of the straight air brake.

Don't get impatient when you think the brakes are not operating to your liking and blame them with containing defects which may exist only in your imagination. It may be that you are not so skillful in handling the brakes as your neighbor. Think a little when such a trouble is upon you. You may find the remedy and learn something more than you already know.

Don't blame the fault on the brakes "failing to act," in an accident which may happen your train. It's wonderful how well they acted, and, as usual, just *before* and *after* such disasters, when anything was left of the train to make a subsequent trial. Somebody might discover this. Maintain your air pressure properly, apply brakes in a reasonable season, and you'll stop promptly as usual. *The Westinghouse Automatic Brake don't fail to act if you have done your duty.*

Don't cut out your driver brakes imagining they are causing your driving boxes injury. This reasoning was exploded long ago. Keep up your wedges and you'll have no trouble, we assure you, and you'll have a valuable stopping device which you may sometime need. Don't use your driver brake as an emergency device only. You may sometime in an emergency not have time to get it to work or you may forget it's on your engine. Instances of this kind have been known to occur. Cut it in and use it in conjunction with train brakes always. Your train will stop ever so much quicker. It will also probably occur to you that if you do not the cars you are hauling will have to stop your engine.

Don't reverse your engine when the driver brakes are applied. If properly designed they will give all the resistance to revolution the driving wheels will comfortably bear. Retardation of movement is less with sliding wheels than when revolving with brakes applied.

Don't imagine you must have 100 lbs. of air or more, when 70 will produce the greatest braking force the wheels will bear without sliding, if the proportions of the brake gear are properly calculated. This you can readily ascertain to your satisfaction, by making use of the simple rules contained in the instruction book. If they are not, call the attention of the proper official to the matter.

Don't imagine you can stop a long train of cars by operating the brakes on a few of the head ones next the engine, in as short a distance as if the entire number of cars in the train were fitted with brakes, and because you can't increase your air pressure in an attempt to do so. Half a dozen to ten cars braked will handle a train of 25 to 40 cars quite nicely on ordinary grades, if properly used, but they can be made to do so much and no more.

Don't set up the rear of a train by applying the brakes suddenly at the head end in an ordinary stop. It's so easily done the right way and pleasanter to the crew in the caboose. Apply the brakes gently until you have the slack of the train against your engine.

Don't think that your old friend, the three-way cock, is going to survive always, just because you're used to its ways, and you are just a little loth to try something better in the new brake valve. You'll get used to the new one shortly, and it is really needed, as the injector was when it took the place of your pump. Don't you remember what you said about the change? Injectors are a good thing *now*, aren't they, since you're used to them?

Don't blame the mechanism of the brakes as being the primary cause of triples "sticking" in ordinary practice. We'll assume, for the sake of argument, they do sometimes fail to release, but did it ever occur to you that it might possibly be caused by your peculiar method of operating the brakes, or that your main reservoir was too small? With a fair show, triples don't "stick." Don't argue to the contrary. The facts asserted *can be* demonstrated.

Don't "cut out" the brakes on any cars in the train unless there is something wrong with the brake gear. Even then a little thought and judgment may enable you to apply the remedy. Operate them all. There's just a little trick in doing it on a long train, but you can learn it easily if you'll only try. Here is where the excess pressure comes particularly handy, and helps you out. Besides, you can stop quicker.

Don't make more than one application of the brakes in stopping at a station, or two at the very outside. Your passengers also notice this and make observations on your skill. The traveling public are very knowing and critical these days.

Don't exhaust train pipe pressure to zero in applying brakes. It don't do any good. They are on as hard as they can be applied long before this, and you waste the difference in air. If you've been addicted to this practice in the past, now is a good time to reform. Somebody who knows better will find out your practice and tell it as a joke on you at the round house or lodge room.

Don't fail to take up the slack in the brake gear when necessary. If you don't, you can't stop so quickly, and it takes more air when the pistons bottom on the front heads. If your brake gear is weak and contributes to this defect, stiffen it up. It pays to do so, and wooden brake beams are out of date. Metallic beams are cheaper in the long run and better.

Don't think because a six-wheel truck car has an air brake on it, and shoes acting only upon four pairs of wheels, it can be stopped as quickly as a four-wheel truck car. It won't, but it can be made to, if shoes are applied to all of the truck wheels, as they ought to be, and it's safer.

Don't for a moment think we are unaware of the fact that the brakes release just a little slower than *you* think they ought. Did it ever occur to you that there was a purpose in having a retarded exhaust of the air in releasing brakes? There is, and a good one. If there wasn't, the exhaust ports would be made larger. Handle the brake properly, and it will release in good season for you.

—*Chain Belting, Elevating and Conveying Machinery. Electric Mining Machinery.* Jeffrey Manufacturing Co., Columbus, O.

The rapidity with which chain belting has come into use in mining, dredging, lumber mill and elevator plants, makes the first of these pamphlets, containing a full description of the chains, a valuable handbook for parties interested in such works. The description of electric mining machinery and motor cars is quite full, and the apparatus illustrated have all the latest improvements. The Jeffrey Co. was one of the pioneer firms in this business, and their machinery is largely used in the Ohio River coal fields. Their electric cutters will make an undercut 5 or 6 by 3½ ft. in 3½ to 4½ minutes, using a current of 30 to 50 amperes and 220 volts. Each moter is wound to develop 15 HP., and has an armature speed of 1,000 revs. per minute. The mining cars are of the Oayor type, and are used with an all-metal trolly line consisting of gas pipes reinforced with copper wire wherever necessary, and avoiding the use of rail circuits for return currents.

—"*Tilly Foster Iron Mines,*" *Souvenir*, issued in honor of the visit, on Oct. 3, of the members and guests of the American Institute of Mining Engineers, including representatives of the Iron and Steel Institute, of England, and the Verein Deutscher Eisenhuttenleute. It is an artistic production in sketch book form showing, in faithful pen drawings, sections of the mine and the various conveying and hoisting devices, drills, etc. This souvenir was the work of the Lidgerwood Manufacturing Co., of New York, Chicago and Boston, the makers of the machinery illustrated. Mr. T. S. MILLER, the engineer of the company had the souvenir in charge, and has done his work well.

—*The Edgar Thompson Steel Works and Blast Furnaces.* Carnegie Bros. & Co., Ltd., Pittsburg and Bessemer, Pa., 4vo, pp. 35.

This very handsome little volume is doubtless an outcome of the visit of the Iron and Steel Institute to this country. It contains a large plan of the works and 24 admirable engravings from pen sketches of as many different features of the works, and an excellent general description of the plant, the largest of its kind in world, and one of the most perfect and complete.

—*The St. Gothard Railway.* By GEO. L. CATLIN, Luzerne, Switzerland, pp. 31.

This is a very handsome illustrated pamphlet in English, describing the advantages of the St. Gothard route in the familiar exuberant style of the American passenger agent, but like its American prototypes and Mark Twain's books, "containing a great deal of useful information."

—*Catalogue of Tramway Cars and Car Materials.*—J. G. Brill Company, Philadelphia, Pa., 4to, pp. 128, 537 cuts.

This catalogue covers very completely all varieties of street cars and street car materials, including not only horse cars, but cable and electric cars as well, almost every detail which enters into any of these cars being illustrated.

—*The Iron, Steel and Allied Industries of Johnstown, Pa.* For the Information of the Visiting Members of the Foreign and American Technical Societies, 8 vo, pp. 37.

Included in the illustrated description of the works, is a short description of the Johnstown flood, and a map of the same.

—*Dyckerhoff Portland Cement.*—Describes the cements made at Amoeneburg, Germany, and contains directions for using Portland cements and testimonials from engineers as to the value of this particular brand. E. Thiele 78 William St., New York. Paper, 12 mo., 46 pp.

SOCIETY PROCEEDINGS.

—Civil Engineering Society of the Massachusetts Institute of Technology.—Meeting of Oct. 17. A paper was read by Prof. GEORGE F. SWAIN on "The History of Bridge Building," with stereopticon illustrations. The officers for the school year are: President, WM. J. ROBERTS, '91; Vice-President, MORRIS KNOWLES, '91; Secretary, A. L. GOETZMANN, '92, and Treasurer, LEONARD METCALF, '92. Next meeting, Oct. 30.

Civil Engineers' Club of Cleveland.—Regular meeting, Oct. 14. Mr. J. H. SARGENT read a paper upon "Railroads, Past and Prospective," showing the development from stone tramways to the latest forms. The especial feature of the paper was the phenomenal advance made within the present generation. After some discussion, Mr. ROBINSON described the projected electric railway of Prof. MARKS, between New York and Philadelphia. Mr. J. B. LARNED then described the Grand Avenue Bridge, at St. Louis, of the stiffened suspension type, and also the new cantilever bridge now building over the Ohio River, between Cincinnati and Newport.

A. H. PORTER, Sec,

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIV. Saturday, October 25, 1890.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTIONS.

To United States, Canada, and Mexico.

One Year, **$5.00;** *6 months,* **$2.50;** *4 months,* **$2.00;** *single Copies, 12 cents. To all* **Foreign Countries** *in the Postal Union, add $2.08 to above prices for postage.*

CLUB RATES.

Two new subscriptions	$9.00
One renewal and one new subscription	9.00
Five new subscriptions	20.00
One renewal and four new subscriptions	20.00

Subscribers *can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses.*

The date *when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance.* **No other receipt** *is sent unless requested.*

Advertising rates, 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia.—Next meeting, Nov. 1. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Society of St. Paul.—Next meeting, Nov. 3. Secy., G. L. Wilson.

Western Society of Engineers.—Next meeting, Nov. 4. Secy., J. W. Weston, 220 La Salle St., Chicago.

Civil Engineers' Club of Cleveland.—Next meeting, Nov. 4. Secy., C. O. Palmer, 22 Cedar Ave.

Engineers' Club of St. Louis.—Next meeting, Nov. 5. Secy., W. H. Bryan, 30 South 7th St.

American Society of Civil Engineers.—Next meeting Nov. 5. Secy., John Bogart, 127 E. 23d St., New York.

Civil Engineers' Association of Kansas.—Next meeting, Nov. 5. Secy., J. C. Herring, Wichita, Kan.

Association of Civil Engineers of Dallas.—Next meeting, Nov. 7. Secy., E. K. Smoot, Elm and Austin Sts.

Technical Society of the Pacific Coast.—Next meeting Nov. 7. Secy., O. von Geldern, 408 California St., San Francisco.

Engineering Association of the Southwest.—Next meeting, Nov. 13. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Western Railway Club.—Next meeting, Nov. 18. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery, Bldg.

Boston Society of Civil Engineers.—Next meeting, Nov. 19. Secy., S. E. Tinkham.

New York Railway Club.—Next meeting, Nov. 20. Rooms, 118 Liberty St.

Engineers' Club of Cincinnati.—Next meeting, Nov. 20. Secy., J. F. Wilson.

Engineers' Society of Western Pennsylvania.—Next meeting, Nov. 21. Secy., S. M. Wickersham, Pittsburg, Pa.

The Buffalo meeting of street-car officials shows in a very marked degree the rapid rate at which electricity is supplanting horses as a motor on our public streets. It is true that out of 3,150 miles of track in 56 cities of over 50,000 inhabitants only 260 miles are as yet operated by electricity as compared with 255 miles operated by cable. But the nature of the exhibits and that of the majority of the papers read at this convention show that electricity is coming. The electric cars of the various prominent corporations in this line of manufacture, an electric snow-plow and snow-sweeper and a variety of novelties of this nature, devised to meet the demands of street traffic, sufficiently prove the live and increasing interest of inventors and manufacturers in this especial line. The application of electric power is yet comparatively new, and some inherent difficulties in the way of street obstruction by poles and wires, or of dead load in the shape of accumulators and motors, have yet to be overcome; but electricity is evidently here to stay, and it now amply meets the requirements of many locations and conditions of traffic.

A SERIOUS attempt is being made to inaugurate a congress of engineers, to be held in Chicago in 1893. The Western Society of Engineers has taken the initiative, and a meeting has already been held with the representatives of some other engineering societies. As outlined, the programme would include a permanent engineering headquarters within the Exposition, a six days' meeting and a separation of the congress into sections including railroad, hydraulic, bridge, steam, marine, military, electrical, mining and mechanical engineering. There would be a chairman and secretary for each section, designated at an early date, whose duty it would be to collect papers and conduct the meetings, and all papers are to be, as much as possible, prepared in advance, and, after examination by a committee, published and circulated before reading at the congress. Intended contributors are requested to confine their papers as far as possible to accounts of new methods or inventions in actual use and to descriptions of novel machines in actual use.

As yet this scheme is in an embryotic state, but it is one that can and surely ought to be carried out to a successful and profitable end. The international meeting of engineers interested in mining and metallurgical industries, now in progress in this country, proves the value of such a congress of allied interests, and shows what could be made of a properly organized effort to assemble the representative men of all branches of engineering, not only in the United States, but from foreign parts as well. The present international meeting of one branch of engineering science is practically the first of importance held in this country, and we think it is safe to say that the seed is sown, and that the interest awakened will bear fruit in the return, in 1893, of a number of those now here, and that their reports of the resources and enterprises of the United States will induce many of their brother engineers to follow. The proposed Congress of 1893 can be made of great benefit to the engineering profession, at home and abroad, by united, vigorous and intelligent effort, and we trust that the beginning made at Cresson and Chicago may meet with that support from engineers and engineering industries that its real influence on national progress so richly deserves.

THE confusion in English brake practice, which has persisted so long, at last gives some sign of ending. It appears from the last half-yearly report that no less than nine different kinds of continuous brake are still in use, including two chain brakes, one of which is in quite large use. But 83 per cent. of the passenger engines and 81 per cent. of the passenger stock is now equipped with either the vacuum or Westinghouse automatic brake, while the percentage of the odd brakes is rapidly decreasing, being now only 13 and 15 per cent., respectively, against 40 and 32 per cent. in 1887. At so late a date as 1882 half the passenger engines and 39 per cent. of the carriages were without any form of continuous brake, and less than one-third of the passenger stock was equipped with automatic brakes. At present, it is plainly only a matter of a year or two when the entire passenger stock will be equipped with automatic brakes of some kind, but according to present indications only about one-third of the equipment will have the Westinghouse automatic, the remainder having the much less efficient vacuum automatic. As for freight stock, there does not as yet seem to be more than the beginning of a movement to equip it with train brakes, the smallness of the vehicles and the loose couplings used making it a much more difficult matter than here.

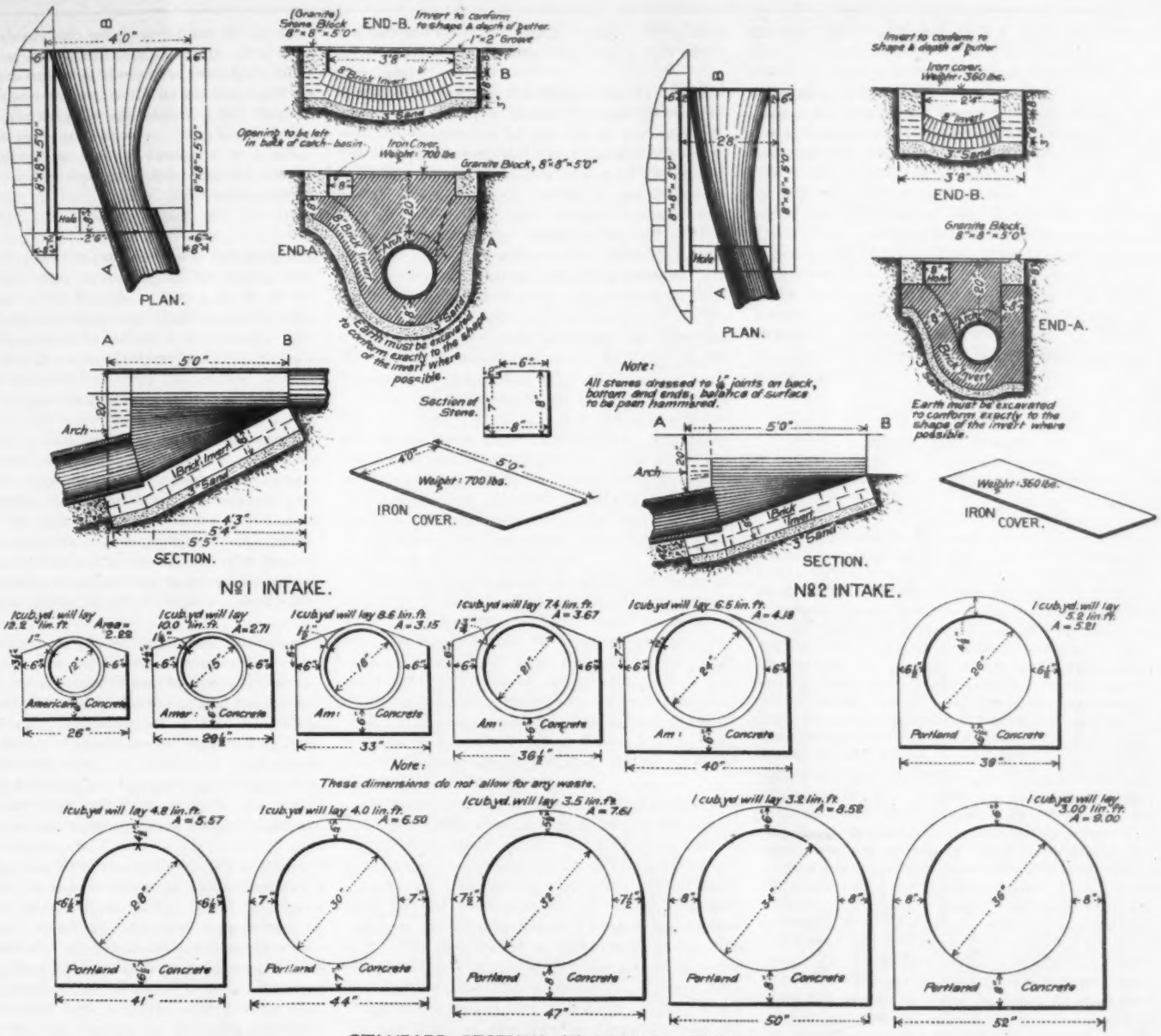
THE survey of our Alaskan territory, as ordered by the late Congress, is a wise measure none too early determined upon. The appropriation, $100,000, is not an eccessively liberal one, but expended by U. S. Army officers it will make a very good beginning. Beyond the somewhat meagre reports of Lieutenant SCHWATKA on the Yukon basin, we literally know nothing of a territory as large as the thirteen original States, and which contains one of the longest and broadest rivers and some of the highest mountains on this continent. We only "suppose" that the interior is a vast, mountainous, inaccessible, ice-bound waste, and it is time that this bit of our geography was verified. What are now fertile plains, dotted with thriving towns and gridironed with railways, figured on the maps of our school-boy days as "The Great American Desert," and something like this change in public estimation may take place in regard to parts of Alaska. It is not probable that our most northerly and latest acquisition in real estate will ever become populous; but it is wise to study its resources, and make some intelligent estimate of what the country really contains, and how best to utilize its possible treasures for the good of mankind.

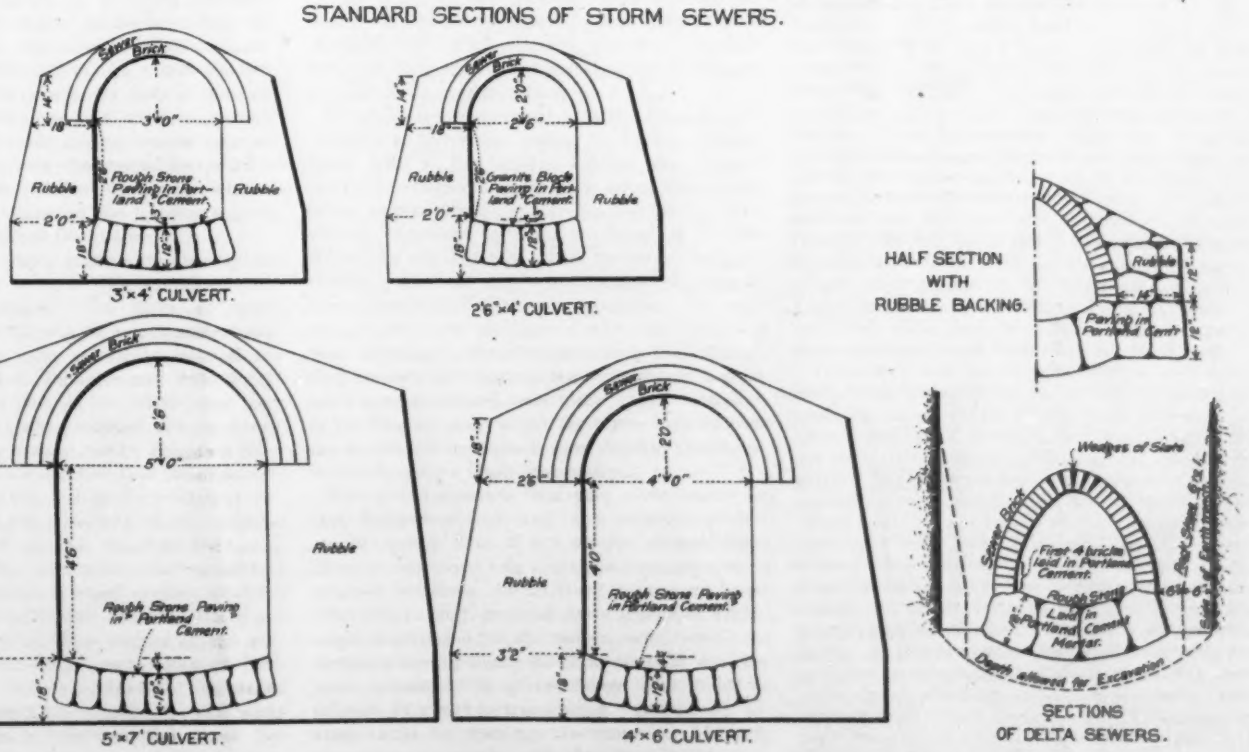
The Channel Tunnel.

The world has heard much of the proposed tunnel under the English Channel, and the preliminary work already done upon it has proven its feasibility as an engineering enterprise. But for some years now all progress has been stopped by the action of the British Government in paying heed to absurd fears that any such tunnel might in the dim future serve as a channel of invasion. The problem is an interesting one, however, from the engineering features involved, and as we have lately had a long talk with Col. F. BEAUMONT, whose inventions have done practically all the work so far accomplished on this tunnel, we give a short description of the novel means employed and the gigantic nature of the operation.

All geologists admit that the English Channel separates two lands once joined, the waterway having been cut in the first instance by an action analogous to that which has created the deep cañons in this country and the channel has been enlarged by the subsequent action of the tides; the high chalk cliffs seen on approaching Dover from the sea find their exact counterpart in those on the French coast; both sides showing identical lines of stratification, while the bottom of the sea has been found by soundings to preserve the outcrop of the different strata in unbroken line from coast to coast. The sequence of the formation is cherty flint on the top, white chalk with flints, then white chalk without flints, under which comes the chalk marl, next the upper greensand carrying a little water, then a considerable stratum of gault, below which is the lower greensand invariably heavily charged with water.

The tunnel is located in the chalk marl about 20 ft. above the upper greensand. It is designed so as to have 150 ft. between it and the bottom of the sea, and as the sea is rough and over 150 ft. deep, it follows that the tunnel will be 300 ft. below the surface. The soundings above mentioned showed, from 6,000 specimens brought up, that the outcrops of the various strata, though continuous, were not in a straight line; hence the condition of keeping 150 ft. of chalk cover, and being within 20 ft. of

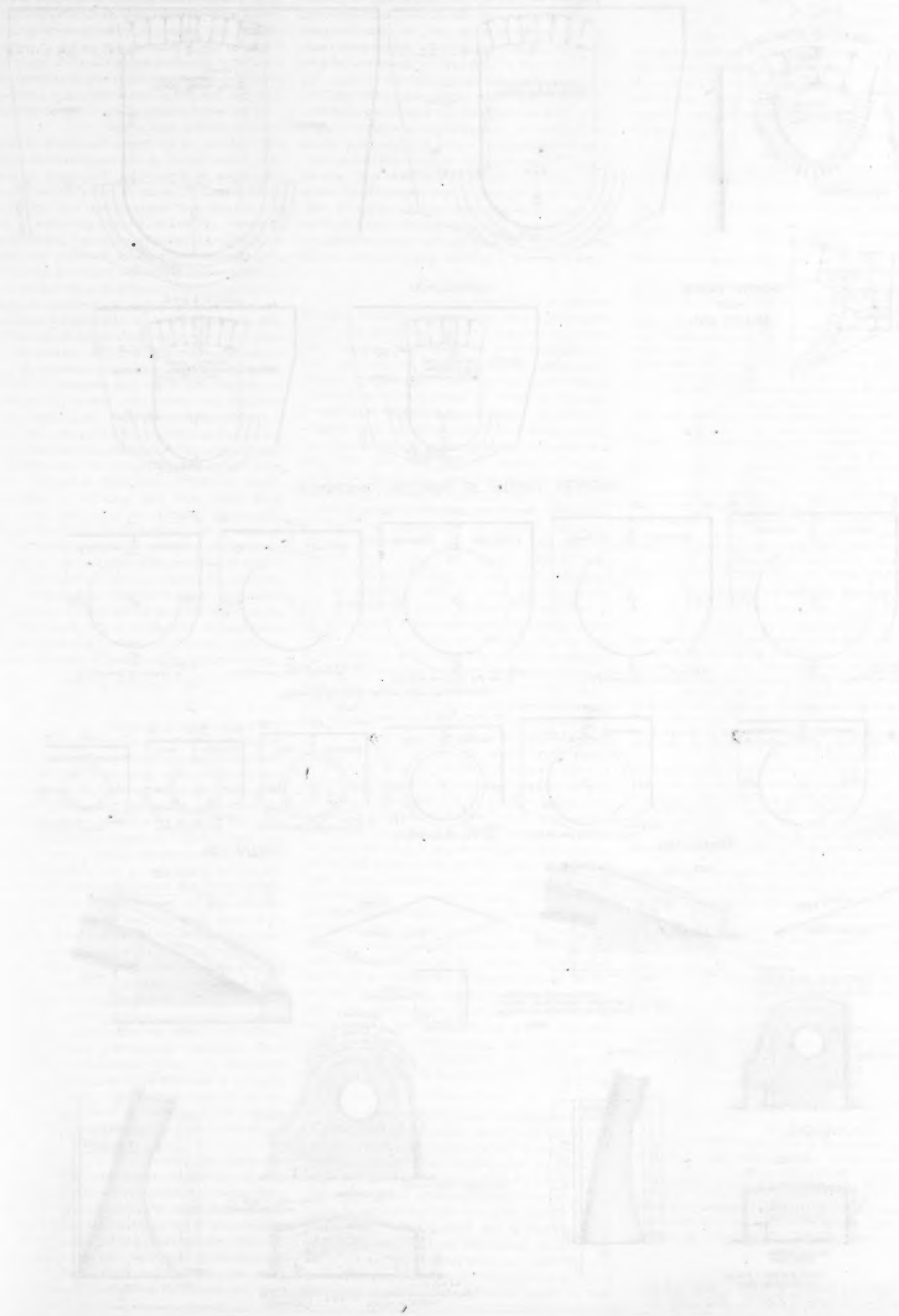

PLAN.
END-B.
END-A.
SECTION.
Section of Stems.
IRON COVER.
Note:
All stones dressed to ½" joints on back, bottom and ends, balance of surface to be pean hammered.
Earth must be excavated to conform exactly to the shape of the invert where possible.
Nº1 INTAKE.
Nº2 INTAKE.
Note:
These dimensions do not allow for any waste.
STANDARD SECTIONS OF STORM SEWERS.



APPROVED PLANS FOR STORM SEWERS AT DULUTH, MINNESOTA.

W. B. FULLER, CITY ENGINEER.

CHAS. HART & SONS, LITH., 39 VESEY ST., N.Y.



the upper greensand, involved the line of the tunnel being curved under the sea portion. The total length of the tunnel is 30 miles, of which 20 miles would be under the sea, and 5 under the land on either side, forming the approaches to the English and French sides, respectively. The latter would join the Northern Ry. of France 7 or 8 miles on the Boulogne side of Calais and the former would connect both with the Southeastern, and London and Chatham lines, not far from Dover.

When the work was stopped some 8 years ago, a mile had been done on the English side and a similar distance on the French. Thus a tenth of the whole distance under the sea stands now completed so far as the advanced gallery is concerned. On the English side a 4-in. plunger pump, working a few hours occasionally, keeps the heading clear of water, and since the ground was opened the flow of water, if such it can be called, has been found to diminish. The water is not salt but slightly brackish, and when the stream was cut by the machine it appeared to be under some pressure which rapidly disappeared as the cutting progressed. In fact the water was no more than a little reservoir which had probably been imprisoned since the chalk was deposited. For the advanced heading no lining was required except in a few places where the strata were accidently disturbed.

A machine is now lying below, and near the end of the Dover pier, with the air connection complete and in such order that in five minutes the compressed air could be turned on and the driving toward France recommenced at the rate of one yard per hour. As work would be carried on from France simultaneously, a couple of years would have been sufficient for the headings to have met, and had the work not been stopped, the trains would have been running three or four years ago between London and Paris.

The machine with which the work was done on both sides was the invention of Cols. FREDERICK BEAUMONT and ENGLISH, of the Royal Engineers. It weighed about 40 tons, and was driven by compressed air. The machine consisted of a very massive cutter-head in the shape of a single cross arm, the diameter of the tunnel to be cut (between seven and eight feet). It was armed with cast-iron cutters and carried by a heavy steel shaft geared to the motor engine so as to reduce the speed some 100 to 1. The cutter-head, shaft, gearing and engines were placed on a cast-iron bed, sliding longitudinally on a heavy steel semi-circular bed plate extending one-third of the way round the bottom of the tunnel; the connection between the upper and lower beds was formed by means of a screw feed capable of variation, so that each revolution of the head advanced the heading a given distance, unless it forced the bed back.

The difficulty in hard ground of keeping the machine to its work was one which required some ingenuity to overcome. The form of cutter found best suited to the work was a circular sharp-edged chisel of cast iron, especially selected for hardness, about 4 ft. in diameter and 2 ins. thick. These were so fixed that as the edges wore they could be turned, and when blunted all around they were recast. These cutters cost in England $25 a ton, with $5 return for old metal, or $20 a ton net.

The dirt as it was cut fell to the bottom of the heading, whence it was picked up by two suitable scoops, one on each side of the bore-head, and dropped as the scoop rose above the central arm into a hopper, whence a series of endless buckets, passing completely under the machine but above the bed plate, delivered it into wagons at the rear of the machine. The engines were a pair of horizontals with 12-in. diameter cylinder. The stroke of the advancing screw was about 4 ft., and when it was run out jacks attached to the upper bed lifted it and the lower bed clear of the bottom, when on reversing the screw the bottom bed was slid forward ready for another start. With men accustomed to the machine this was a very short operation.

Before the work on the French side was stopped a trial was made to prove the maximum speed which it was possible to get out of the machine. The trouble all along had been to get the dirt away, for in the uncertain political aspect of the undertaking, it was obviously useless to get the necessary air locomotives, and acquire a proper train service; hence for the above mentioned trial all available men and wagons were collected handy, and the dirt was all taken clear of the machine. Under these circumstances 8 ft. forward was cut in 80 minutes, or a foot every 10 minutes. With the imperfect arrangements obtained for removing the debris, 26 metres, or about 87 ft., was the best progress obtained in 24 hours.

The tunnel was proposed to consist of two single-line openings, the ruling grade being 1 in 80 and the portion below the sea nearly level. The drainage was to have been effected from the center by special drainage headings, which would be located in the chalk marl, the same as the railway tunnel, but at a different inclination. The drainage tunnel would emerge on either coast some distance from the mouth of the tunnel proper.

The lining of the tunnel necessary for the security of the train from chance falling lumps was to have been of concrete. The shingle necessary is found on the shores not far from the site, and the cement would have been made from the chalk marl cut in process of construction. It is this chalk marl which is used by the extensive cement works at Boulogne, and it makes as good a cement as any to be found in France. The cost of the work would be about $20,000,000, and the tunnel could be completed in four years.

In the early stages of the work the English press and the public were loud in its praise, not doubting its value commercially, but hesitating only to pronounce an opinion on the practicability of so gigantic an undertaking. Both the Conservative and Liberal Governments gave an emphatic approval to the principle of a tunnel, and in concert with the French a joint commission was appointed, and met to settle certain generalities concerning the international character of the traffic. After much money had been spent by the French on the faith of the English Governmental expression of sympathy (if nothing more), the English changed their mind, stopped the work on their end, and once again gave occasion for Gallic outcry against *la perfide Albion*.

Of course it is recognized that the English government is powerless unless it carries Parliament with it, but neither Liberal nor Conservative Governments have done other than themselves oppose the scheme in the face of their previously expressed opinions in favor of it. The objections are entirely raised by the military authorities who say they were dormant so long as the matter looked to them impossible, and only woke up to form an opinion when the work was well advanced. Their argument is that though they concede that with 12 hours' notice no danger need be apprehended, they think that the mouth of the English end might be taken by a *coup de main*, which if the French were aided by treachery, would be quite a feasible operation.

This would appear to be a poor compliment to their brother officers, and any thinking person would realize that it is a simple impossibility. Were symptoms of war to appear without previous strained relations, all railroad managers know that, before any unusual development of traffic could be provided for, the requirements would be known generally along the line, so that warning must necessarily be given before even a lot of schoolboys could be transported. Of course, arrangements for flooding the tunnel or blocking the entrances could be made; but they are unnecessary, for a truck load of dynamite run down the incline on either side and fired a mile from the shore would so damage the land approach that it would be quicker to construct a new line than to retunnel through the broken ground.

As to the commercial aspect of the question, if it was found to pay to construct the Forth bridge to connect by a shorter line than already exists two comparatively insignificant parts of Scotland, can there be any doubt as to the value of a line that would cost little more than double that of the Forth bridge, and join two of the largest railway systems of the world? The value of the tunnel as a commercial undertaking appears to be conceded.

The work on the English side was done by a limited company, of which Sir ED. WATKIN is chairman, and that on the French side by a similar organization, in which the ROTHSCHILDS are largely interested.

Notes from Abroad.

[EDITORIAL CORRESPONDENCE.]

ENGLISH RAILWAYS.

During my stay in England I have traveled considerably on all kinds of lines and in all kinds of trains, so that I have had plenty of opportunity to study the railways, their track and their equipment. The usual type of track is of course that consisting of bull-head rails supported in cast-iron chairs, in which they are secured by wooden wedges or keys. The chairs are secured to the ties by fang-bolts, screw spikes, plain round spikes or treenails; generally a combination of two of these fastenings is used. Each road has a practice of its own, using its own form of chair and using two, three or four fastenings for the chairs. The Northeastern Ry. is trying steel flange rails weighing 90 lbs. per yd., carried on steel cross-ties, and the Furness Ry. has a trial section laid with Mr. C. P. SANDBERG's 100 lb. per yd. "Goliath" rail (flange section) and tie-plate. The rail joints are usually square and suspended, but broken and supported joints have also come within my observation, and of some of these I have made sketches. For heavy traffic the splice bars are generally deep, projecting below or under the rail; but I have also seen angle splice bars for bull-head rails. Flange rails are used on main track on some small lines, and are extensively used for side tracks; they are secured by square spikes, or by bolts passing through the flange, and the joints are spliced by plain bars. The bridge rail designed by Mr. BRUNEL is still generally used on the broad (7 ft.) and mixed (7 ft. and 7 ft. 4½ in.) gauges on the Great Western Ry.; also to some extent on its older standard gauge lines. It is also used by other roads on bridges and in shops. It is also used, in a heavier form, on the Forth Bridge. This form of rail is bolted to longitudinal timbers and the joint is spliced by a tie-plate having a rib on its upper side, which fits into the hollow of the rail. No splice bolts are used, but the bolts at the rail ends pass through the rail, plate and longitudinal. Where square-headed track bolts are used the splice bar is usually slightly grooved. On the Southeastern Ry. I have seen a few Samson bars. In no case have I seen long splice bars, 18 to 24 ins. being generally used; nor have I seen more than four bolts used.

The switch and signal equipment is very complete. The block system is, of course, generally used, but on some of the smaller lines different systems of train-staff, generally electrically controlled, are used. The signals are of the ordinary semaphore pattern, but the Great Northern Ry. has the blades centrally pivoted, moving to a vertical position for "track clear." Some signals of old types may occasionally be seen. In approaching large cities there is some trouble, owing to complication and confusion of signals; and in order to reduce this to some extent the Great Northern Ry. uses green for a "track clear" light; white being only used for back lights. In this connection I have received some inquiries as to the practical efficiency of the Koyl parabolic signal, which has an illuminated blade. (See ENGINEERING NEWS, Sept. 28, 1889.) Two main line track crossings at grade I have seen; at one the train was slowed down slightly, but at the other (on a different line) there was no change in the speed. De-

railing switches, or "catch points," are used on the up-tracks of steep grades to prevent accidents in case of a train breaking. The use of the "communication cord" is compulsory on trains making runs of more than 20 miles without a stop; the cord is run along the edge of the roof on the right hand, or "off" side of the train and rings a gong on the engine, being practically the American bell cord. On some lines there is an electric alarm which rings a bell in the guard's car and on the engine; on pulling the knob for this alarm a small red disk flies out at the side of the car, indicating from which car the alarm has been given. In case of emergency the guard can apply the continuous brakes by means of a valve in his compartment. I have not found so much punctuality in the running of trains as I had expected, and there is frequently unnecessary delay at stops, instead of trying to save time when late. This does not refer to the local trains in and around London, which are run very regularly.

ENGLISH LOCOMOTIVES.

The express engines of English railways are, as a rule, very handsome and powerful machines. There is no general similarity of type, as in America; but each road has various types of its own. Inside cylinders are most general, but outside cylinders are in favor on several roads. Equalizing levers for the springs are used on some roads. The use of the "bogie," or truck, is extending very widely, and a very common type of engine for fast passenger service has four coupled driving wheels and a four-wheel leading truck. The truck wheels are generally larger than is usual in the United States, and the driving wheels are also frequently larger. Thus four coupled driving wheels of from 6 ft. to 7 ft. 6 ins. diameter, and single driving wheels of 6 ft. to 8 ft. diameter are in general use. Some new engines of the Lancashire & Yorkshire Ry. have four coupled driving wheels 7 ft. 6 ins. diameter, a four-wheel leading truck, and inside cylinders 19 × 26 ins. Among the leading single driver express engines may be mentioned the Great Western Ry., with 8-ft. drivers, four leading wheels (not in a truck frame), and a pair of trailing wheels; the Great Northern Ry., with 8-ft. drivers, a four-wheel leading truck, and a pair of trailing wheels; the Caledonian Ry. has engines similar to the latter. The first two engines represent types which were designed many years ago, and are still in operation. Tank engines are in very general use for local trains and for runs of up to about 25 miles. For passenger traffic these engines have various arrangements of wheels: some six-wheeled (all coupled), and some with four coupled driving wheels, single leaders or trailers (or both), or with a leading or trailing truck. Side tanks are generally used, but saddle tanks are also to be seen. Freight engines have generally six wheels, all coupled; and tank engines for freight service have the same arrangement. On the Lickey incline, Gloucester & Birmingham line (Midland Ry.), a six-wheel (all coupled) tank engine is used as a pusher. On some of the local lines in and about London there are very fine tank engines.

Nearly all modern built engines have cabs affording a good shelter to the men, but the men must stand up while at work. The old fashioned weather-board is still in use, however, with its various stages of development before the present cab was reached. Many tank engines have the foot plate quite covered in, except an opening at the sides for entrance and exit. On these engines the men are sheltered whether they are running smoke stack or bunker first. In appearance the engines are, as a rule, very bright. On some roads they are painted black, relieved, however, by red or white striping; but on most roads they are painted a standard color or shade of green, yellow, brown, blue or red, picked out by artistic striping, and relieved sometimes by painting the frames a contrasting color. Here are a few samples of the main coloring: Great Western Ry., dark warm green boiler, cab, wheels and tender, Indian red frames, black, red and yellow striping; Great Northern Ry., bright light green as above, chocolate frames, black and white striping; Midland Ry., bright brownish crimson all over, black and yellow striping; Caledonian Ry., dark blue, with plum color frames, black and white striping; London, Brighton & South Coast Ry., yellow ochre, with chocolate frames, black, green and red striping. Green is the color most generally used, in various shades of bright and dull. Following are the leading dimensions of three of the express engines which I have seen:

	Great West. Ry.	Great North. Ry.	Lancashire & Yorkshire Ry.
Driving wheels	Single. 8 ft. 0 in.	Single. 8 ft. 2 ins.	4 coupled. 6 ft. 0 in.
Leading "	Four. 4 ft. 6 ins.	(Truck.)	Truck. 3 ft. 0½ in.
Trailing "	4 ft. 6 ins.	(Single.)	6 ft. 0 in.
Cylinders	18 × 24 ins.	18 × 28 ins.	18 × 26 ins.
Tubes, number	300		220
" length	11 ft. 1 in.		About 11 ft.
" diam. (out.)	2 ins.		1¾ ins.
Heating surface	1,767 sq. ft.	1,045 sq. ft.	1,229 sq. ft.
Grate area	25.40		18.75 sq. ft.
Weight		77½ tons.	43 tons.

E. E. R. T.

CORRESPONDENCE.

The Red Rock Cantilever Bridge Correction.

PHŒNIXVILLE, Pa., Oct. 9, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: We notice in the article on the Red Rock Cantilever in your issue of Oct. 4 that the design is credited entirely to Mr. J. A. L. WADDELL. We think, as this statement is not correct, or at least not complete, and as it was probably inadvertently made, that it is only just that the credit for this design should be placed where it properly belongs; namely, in the engineering office of the Phœnix Bridge Co.

Mr. WADDELL, as Western representative of this company, and a member of the engineering staff, rendered material assistance in the designs and estimates, but they were entirely worked up by the engineering office of the Phœnix Bridge Company. Hence the naming of one person as designing engineer is not only invidious, but the commission of an injustice to that company. Trusting that you will give this letter equal publicity with the article in question, Yours very truly, HENRY W. HODGE.

[We have already published a correction of this error in a former issue. We should add that Mr. WADDELL himself was not responsible for the error. It arose through the Chief Engineer of the railway company. Following copy furnished us, it seems we also erroneously gave credit for conducting the deflection tests to Mr. R. D. ROWE, instead of to Mr. S. M. ROWE, the Chief Engineer.—ED. ENG. NEWS.]

142,857.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In an old number of the NEWS you give some curiosities of the number 142,857, most of its products having the same digits, differing only in order, as seen below:

142857 × 1 = 14 2857	142857 × 5 = 7 14285
" × 2 = 2857 14	" × 6 = 857 142
" × 3 = 42857 1	" × 7 = 999999
" × 4 = 57 1428	" × 8 = 1142856;

and the last product, if we take the first digit and add it to the last one, becomes 142,857 = 142,857 × 1. Thus each product (except that by 7 and after modifying that by 8) contains the same digits as the number itself and arranged in the same succession, although beginning at different points.

It may be added that, by continuing in this way (adding the first digit of each product to the last one), the same peculiarity is seen to obtain in the higher multiples, thus:

142,857 × 9 = 1,285,713
and 285,714 = 142,857 × 2
142,857 × 10 = 1,428,570
and 428,571 = 142,857 × 3
142,857 × 11 = 1,571,427
and 571,428 = 142,857 × 4
142,857 × 14 = 1,999,998
and 999,999 = 142,857 × 7
142,857 × 15 = 2,142,855
and 142,857 = 142,857 × 1
142,857 × 22 = 3,142,854
and 142,857 = 141,857 × 1

and so on; each increase of 7 in the multiplier bringing us around to the same point. Thus:

142,857 × 57 = 142,857 × (22 + 5 × 7)
= 8,142,849
and 142,857 = 142,857 × 1. T.

[If any one can give a reason why this number should have this peculiarity, we should be pleased to publish it. Its factors are 3 × 3 × 3 × 11 × 13 × 37, which do not seem to be such as to hint at any explanation.—ED. ENG. NEWS.]

San Diego Sewerage.

NEWPORT, R. I., Oct. 9, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to the last communication of the City Engineer, of San Diego, published in your issue of March 22, I beg you to publish the following, written in response to a request for a statement concerning the working of the system:

"OFFICE OF THE SUPERINTENDENT OF SEWERS,
"SAN DIEGO, Cal., Sept. 26, 1890.

"The sewerage of this city was planned by Col. GEO. E. WARING, Jr., of Newport, R. I., and was constructed under his supervision. The total length of sewers is 211,130 ft.; of these 172,000 ft. are 6 ins. in diameter.

"The system has been in use since the summer of 1888. In making about 3,000 house connections we have found only two small leaks in the joints of the sewers. The number of houses actually connected with the sewers is 1,200.

"During the entire working of this system there has been only one stoppage in the sewers, and that was caused by a laundry not being properly connected.

"The whole system has worked to the entire satisfaction of our community, and those who originally expressed doubts as to the capacity of the pipe sewers are now perfectly satisfied as to their adequacy.

"(Signed) S. T. GOLDTHWAIT,
"Superintendent of Sewers."

"I consider the sewer system of the city of San Diego to be the most perfect enjoyed by any city on the Pacific coast. It has proved thoroughly satisfactory from the beginning, and with extensions, as new territory shall be built upon, will undoubtedly prove adequate to the requirements of ten times the existing population.

"(Signed) DOUGLAS GUNN,
"Mayor."

It seems to me that this is a very fair showing. Very truly yours, GEO. E. WARING, Jr.

Watches as Compasses.

BIG STONE GAP, Va., Oct. 8, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I inclose a clipping from LABOUCHERE'S London *Truth*, which will probably be as much news to most engineers as it was to Mr. STANLEY, and is evidently a handy thing to know. It is correct at noon, and at 6 A. M. and 6 P. M. Its greatest error in this latitude (37°) is about 15° (or half of an hour space) at about 8 A. M. and 4 P. M., the watch making the meridian too far east in the former and too far west in the latter case.

Yours very truly,
JOHN MARSTON, JR.

"A few days ago I was standing by an American gentleman, when I expressed a wish to know which point was the north. He at once pulled out his watch, looked at it and pointed to the north. I asked him whether he had a compass attached to his watch. 'All watches,' he replied, 'are compasses.' Then he explained to me how this was. Point the hour hand to the sun, and the south is exactly half way between the hour and the figure XII. on the watch. For instance: Suppose that it is four o'clock. Point the hand indicating four to the sun, and II. on the watch is exactly south. Suppose that it is eight o'clock, point the hand indicating eight to the sun, and the figure X. on the watch is due south. My American friend was quite surprised that I did not know this. Thinking that very possibly I was ignorant of a thing that every one else knew, and happening to meet Mr. STANLEY, I asked that eminent traveler whether he was aware of this simple mode of discovering the points of the compass. He said that he had never heard of it. I presume, therefore, that the world is in the same state of ignorance. AMALFI is proud of having been the home of the inventor of the compass. I do not know what town boasts of my American friend as a citizen."

An Early Ice-Breaking Steamer.

KANSAS CITY, Mo., Sept. 17, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In connection with the article on the ice-breaking boat "Nogat" in your issue of Sept. 6, the following may be of interest.

In 1863 the Grand Trunk and Vermont Central railroads wanted a car ferry at Ogdensburg, N. Y., which could keep the river open all winter. The rapids commencing some three miles below gave means of disposal for the ice, but at and between the ferry wharves it formed from 12 to 30 ins. thick, the heavy ice forming in the slips behind the bar, where there was no current and shoal water. As the formation of ice is sometimes very rapid, and under circumstances similar to those described for the "Nogat," the requirements were for large power and light draught.

We had no data at the time except for such side wheelers as were used at Detroit and Havre de Grace. The great cost of these resulted in the building of the *St. Lawrence*, the lines of which are given herewith.

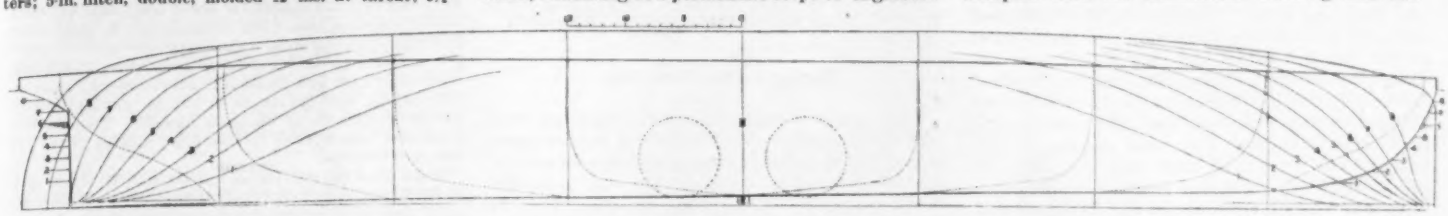
It was 125 ft. over all; 31 ft. beam; drew about 8 ft. of water; was driven by twin screws of Buffalo pattern, remarkable blades, 7 ft. diameter, pitch about 10 ft. Each wheel was driven by a pair of locomotive engines set on nearly horizontal bed plates, the shaft of one engine being longer and passing under the other pair of engines. The exact size of the engines I do not recollect; they could turn the wheels at the dock so fast as to throw the water out of them. Locomotive boilers were used, one on each side and in the hold, the smoke stacks passing up outside of the (double) tracks on deck. The saloon and pilot house were overhead. The boat carried 6 cars.

The boat was used in precisely the manner described for the "Nogat," breaking the ice down rather than cutting through it. But being of nearly 400 tons was correspondingly more effective. It was timbered solid between about water lines 2 and 7, from about frame *I* forward, and sheathed with ⅛ and 3-16 iron, with inch iron on the stem; there was never a plank or leak started by ice in the whole life of the boat, and though the bottom was

flatter than we desired, and the lines very full, it never gave any trouble, and was very successful. more so than some which have been built since with finer lines and less carrying power. So far as the writer is aware, this was the first boat of this class.

The boat was built of oak, frames 20 ins. between centers; 5-in. flitch, double, molded 12 ins. at throat; 9¼-in. bilges, 6-in. timber heads; planks, 3 and 3½ ins. The keelson was the lower chord of a truss carrying the deck.

GEO. W. PEARSONS.



AN ICE-BREAKING CAR FERRY STEAMER.

Notes and Queries.

A correspondent wants information as to the comparative practical merits of the Cram, and the Vulcan-Nasmyth steam pile drivers.

A. M. M. asks: Can you give me the title of the best American treatise on the manufacture of iron and steel?

The best book by long odds on this subject, one of the most complete and accurate of any on a like subject ever issued, is HOWE'S "Metallurgy of Steel," $10, a full review of which will shortly appear in these columns. It is a book which no one interested in steel should be without, and its price is very low in proportion to its size, completeness and value.

The Government Engineers of France.

As the conduct of public works in France has often been quoted as a model upon which to reorganize our own government engineering staff, the following sketch of the history, duties and responsibilities of the French government engineering corps is prepared from the *Dictionnaire de l'Administration Française* of M. MAURICE BLOCK.

Briefly sketched, this corps of engineers is recruited from the national engineering school, the *Ecole Polytechnique*, and it is their duty to arrange plans for and to superintend the construction of public works, including in these harbors, lighthouses, roads, bridges, etc., executed at the expense of the government. They also superintend all government contract work, render estimates and keep the accounts. Construction companies and private corporations building canals and railroads also very generally put their work of an engineering character into the hands of the government engineers, who are temporarily detached from the state service in such cases, without losing their grade or rights of advance in the service.

The history of this corps is briefly as follows: As a consequence of certain disastrous events to France, the rulers of that country in the sixteenth century commenced to direct their attention to the improvement of the ways of communication, that they might be better available for military purposes, and also better serve the needs of agriculture and commerce. To this end FRANCIS I. ordered the construction of a canal between d'Ille and Rance, in Brittany, and in 1535 first considered the project of a canal between the Atlantic ports and the Mediterranean Sea. In 1607 HENRY IV. appointed an Inspector-in-Chief of road, whose duty it was to improve and keep in repair the main highways, and in this same reign was commenced and almost completed the Canal de Briare, the first canal proper built in Europe. This work was finished under LOUIS XIII. by the first concessionary company of which there is any record. Under LOUIS XIV. the Canal du Midi was awarded to RIQUET, who was recognized as its proprietor; but to complete it he received heavy subsidies from the crown, and also from the government of Languedoc. COLBERT, who controlled this great work, was also much occupied with routes of travel in various parts of France, and he put the execution of these in the various provinces into the hands of architects who were known thereafter as royal engineers.

The national reverses which signalized the end of the reign of LOUIS XIV. again made it the policy of the State to encourage in every way possible the agriculture, industries and commerce of France, and to this end the Regent approved of a project for covering the entire royal territory with a network of roads, aggregating about 12,000 leagues in length. To execute this vast plan he instituted, in 1722, the department of *Ponts et Chaussées*, or bridges and roads, consisting of a permanent corps of engineers with two chiefs at its head, one who disposed of financial and administrative questions, and another who was the most eminent engineer in France and attended to technical matters. Both of these officials were under the authority of the controller general of finances.

In the course of about fifty years the system of magnificent roads which now cover the entire territory of France was completed under the direction of the two TRUDAINES, father and son, and the famous PERONNET. This work is beyond question the most remarkable monument of the reign of LOUIS XV., and one in which any ruler might justly take pride.

In 1750 the *Ecole des ponts et chaussées* was founded and placed under the direction of PERONNET, and the departments of Languedoc and Brittany soon after established schools modeled upon that at Paris. By a decree of Jan. 19, 1791, the Assembly confirmed the rights and duties of this government corps of engineers, with its privileges of succession and a single school, that at Paris. Under the First Empire the corps was reorganized by a decree of Aug. 2⅝, 1804. A director-general was placed at its head under the authority of the Minister of the Interior, and the official school was also reorganized. In 1817 the corps of bridges and roads and that of mines were consolidated under one general chief or head, and in 1838 the whole system was put under the Minister of Agriculture, Commerce and Public Works. In 1839 a separate department of Public Works was created, with an Under Secretary of State, who was charged with the direction of bridges, roads, mines and the administration of their separate schools. In 1853 the Ministers of Agriculture and Commerce again found themselves saddled with the administration of public works, but these duties were again separated in 1869, and so remain.

The Administration.—The central administration of the corps is under the Minister of Public Works, the directors of bridges and roads and railroads, the Council General and the bureaus. The Minister approves of projects for new work or extensive repairs, apportions the legislative appropriations and prepares the decrees relating to the personnel of the engineering staff to the grade of engineers of the second class. The directors attend to the correspondence with the prefects and engineers of the several departments, and prepare all measures of administration which should be submitted to the Minister for his signature. The Council General is made up of inspectors-general of the first and second class, and its office is to advise: 1. Upon projects and plans for work, and upon all technical questions submitted to it. 2. Upon questions of responsibility. 3. Upon all contention arising relative to the administration of water-works. 4. Upon all disputed questions which ought to be submitted to the Council of State or to the Minister.

The territory of France is divided into sixteen inspection districts, each controlled by an official entitled, under a decree of 1855, inspector-general of the second class. These inspectors make each year a tour of their districts, requiring three months' time. The reports of these inspections are sent in, and a prescribed printed form is then filled up from them by the engineer-in-chief. These forms have one margin for the observations of this engineer, and another margin to receive the notes of the inspector of the division. These forms are divided under six heads, as follows: 1. The engineering staff. 2. Roads, bridges and railways. 3. Rivers, canals and docks. 4. Harbors, lighthouses, drainage and dunes. 5. Works, ferries, etc. 6. Accounts. Reports upon the engineering staff may be, by reason of the secrecy often demanded, addressed direct to the minister.

Five inspectors-general of railways are exclusively occupied with the commercial working and the control of the financial administration of the companies. They are members of the consulting committee to railways and form a permanent section, charged with the duty of advising the minister in all matters relating to railways. Their especial duties are to advise in matters concerning: 1. The establishment of rates and their application. 2. Special transport and international conventions. 3. The emission of obligations. 4. The question of loans or subsidies, the guarantee of interest with the companies, or the partition of profits with the State. These inspectors-general of railways have a seat also in the council general of bridges and roads, and also in that of mines, for all things concerning their branch of the public service. This commission forwards, each month, to the Minister a report upon the financial and commercial situations of the several companies, accompanying these reports with statistics relating to the movements of passengers and freight. These monthly reports are consolidated finally into an annual report addressed to the minister.

Department Administration.—To a certain extent, the same questions before treated of occupy successively the attention of the ordinary engineers, the engineer-in-chief, and, above all, the inspector general of the division. These are questions inherent to the service and necessary elements, such as—1. The study and preparation of plans. 2. The preparation and opening of credits. 3. The execution of works by contract or by indirect taxes. 4. The bureaus. 5. The payments for work and the delivery of orders. 6. The discussion of matters in dispute. 7. The movements of the personnel.

For all general projects, such as the improvement of navigable streams, new roads or lines of railways traversing several departments, the plans of the engineers and engineer-in-chief pass to the inspector-general of the division, whose duty before forwarding it is to see that the plans form part of a well-studied general system.

The *ingénieurs ordinaires*, or those below the rank of engineer-in-chief, are particularly charged with the direction of works, both in the field and office. They are required to obtain from the contractors the exact fulfillment of the terms of the contract, and to particularly watch the construction of all more important works, and to themselves make the measurements and verification which precedes the acceptance of any piece of work.

Recruiting, Pay, Etc.—The corps of government engineers is recruited almost entirely from the national school of "Bridges and Roads," and to this school are admitted such students of the polytechnic school as are selected in their order of merit for this particular service. The law of Oct. 30, 1850, however, has reserved one-sixth of the engineering positions for those "conductors" of bridges and roads who have had 10 years' service and present themselves in an open competition, and are adjudged admissible. The conditions of this competition are fixed by a decree of Aug. 23, 1851, and that of March 7, 1868.

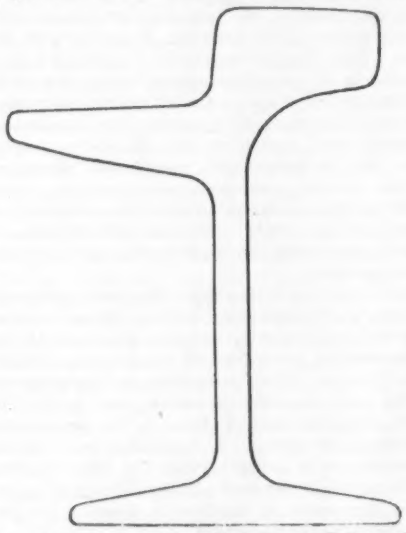
The annual pay of the several regular grades is as follows: Inspector-General of the first-class, $3,000; second class, $2,400; engineers-in-chief of the first class, $1,600 to $1,400; second class, $1,200; ordinary engineers of the first class, $900; second class, $700; third class, $500, and finally engineer students, $360. In addition to this pay they are entitled to a certain sum fixed by the ministry which is to be expended in office rental, pay of secretary and some other necessary expenses. And they are also entitled to a fee and expenses in the case of any work under

their charge which may belong to the department, communes, or associations of proprietors, outside of their regular duties, or for advice in affairs where their intervention is required by law in the general interest. These fees are regulated according to an official tariff.

Engineers are advanced in the corps according to the following rules: Engineers of the third class are those students who have completed their studies at the national school, and they fill all vacancies except the one-sixth reserved for the "conductors" before referred to. Engineers of the second class are those who have seen, at least, two years' service in the lower class, and they must remain at least two years in the second class before they are eligible for the first. After two years in the first class they may become chief engineers of the second class, where they remain for three years before they can succeed to the grade of chief engineer of the first class.

Rail Sections for Electric Railways.

We illustrate herewith the rail section of the new permanent way laid for the electric line of the West End Street Railway Co. of Boston. It will be remembered that this company operates the largest



70-lb. Rail Section, West End Street Railway Co., Boston, Mass.

Scale, 1-2.

mileage of electric railways of any company in the world. Since work was begun on the reconstruction of the tracks about a year ago, over 50 miles have been rebuilt and laid with the new rail shown in our drawing. This rail has a head broad enough to accommodate ordinary street traffic very well, although there is evidently some danger to vehicles in turning off from it.

The grooved rail, which causes least obstruction to the passage of ordinary vehicles, is unsuited to electric railways, as these must necessarily have a good metallic contact between their wheels and the track in order to pass the return current. With a grooved rail in a city street the groove soon gets more or less filled with dirt at the bottom, which acts as a non conductor and interferes with the passage of the current, sometimes so much so as to stop the car entirely.

Another objection to the grooved rail is that light pleasure vehicles with very narrow tires sometimes drop into the grooves and find it more difficult to turn off without injury than on any other form of rail.

To obviate both the above-named objections the experiment has been tried of making a grooved rail having one side of the groove inclined, instead of vertical, as in the rail recently adopted for the Third avenue and Broadway cable lines, illustrated in ENGINEERING NEWS of Aug. 9. It was expected that this would facilitate the turning of carriage wheels running in the groove, and also that the car-wheel would force its way to the bottom of the groove and crowd the dirt out at the inclined side. Unfortunately, the latter expectation was not realized, and although carriages could turn out readily from the track, enough dirt was found to remain in the bottom of the groove to seriously interfere at times with the passage of the electric current.

One fault which may be found with the rail illustrated is that its base is too narrow, making it liable to cut into its support. As the rail is laid on a timber stringer, however, and thus has double the support of a rail laid on ties, it will probably stand up much better than would appear at first glance.

Thomas Slag Fertilizer.

The Thomas or basic process of producing steel furnishes a large amount of slag rich in phosphate of lime, the phosphorus coming from the ore used in the basic furnace or converter. The slag is largely used as a fertilizer in Germany, according to U. S. Commercial Agent SMITH, of Mayence, who reports a consumption of 450,000 tons in 1889, an increase of 230,000 tons over the amount used in 1887.

The slag must be ground quite fine; of the product now in use, from 80% to 85% will pass through a sieve having meshes 0.0059 to 0.0066 in. wide. [The finest sieve in the Am. Soc. C. E. standard cement tests has meshes of 0.01 of an inch formed with No. 40 wire, Stubb's gauge. Prof. KINEH, of the Royal Agricultural College, of England, suggests 120 meshes to the inch.—ED. ENG. NEWS.]

This new phosphate is represented as a more powerful, effective and lasting fertilizer than any other phosphatic manure. A large number of experiments made by farmers are said to show that it is as quick acting as superphosphate on nearly all soils, even when used in summer, and on heavy clay soils poor in lime, on light sandy soils, on wet and sour meadows, and on peaty soil it gives better results than the superphosphate. It contains 50% more lime than the latter, and therefore acts more quickly on lean land than the superphosphate.

The price of the Thomas phosphate powder in Germany in May, the date of Mr. SMITH's report, was about $8.75 per ton, of which weight some 17% is phosphoric acid.

Consul WIGFALL, of Leeds, Eng., reports that in 5 instances the addition of 4 cwts. of basic slag to unfertilized plots of land gave crops greater by 4 cwts., 5½ cwts., 1 cwt., 3½ cwt., and 1 cwt., respectively, than those from similar plots of unfertilized land. In some instances the slag has not only proved beneficial to the crop to which it was given, but also to a subsequent one, showing that its influence is not exhausted in a single year.

The Lake Superior Copper Mines.

The following unusually accurate and vivid account of the past and present of these great mines we condense from an article by E. B. HINSDALE in the New York *Times*:

Last year there were produced 105,588,000 lbs. of refined copper, which, at 17 cts. per lb., amounts to $18,045,620. It is a rapidly-growing industry, and the new openings and additional machinery point to an increased production of at least 25 per cent. for next year.

About $250,000,000 in value have been taken from these famous mines, and yet no one suggests a probable limit to the supply. Native copper is so called because each particular piece of copper as it is mined, whether it be many tons in weight or a fine particle of dust, is pure copper of the same kind and quality as the ingot copper of the world's markets. It is not alloyed with any other mineral except it carries a trace of silver, although pure silver in small quantities is often found imbedded in the copper.

Those who look at a map of Lake Superior will see a peninsula called Keweenaw Point that juts out into the lake from the southerly shore. It is a small bit of land to contain so much wealth. These famous mines are situated along a line about in the middle of this peninsula, and copper has been found at various points along this line for about 50 miles. Ancient works have been found at numerous points for about 30 miles.

There is a deep mystery about these old works that it is impossible to fathom. In the opinion of many they were worked by a race of men that preceded the present Indian race; but others think that they were worked by their ancestors. This much is certain, whoever worked these mines in ancient days, all knowledge of the existence of the mines was gone from the Indians when white men rediscovered them.

The ancient miners were diligent and persistent people. They seemed to know nothing of smelting copper, for there are no traces of molten copper. They were after pieces of suitaole size to work by cold hammering into useful articles and ornaments. They understood the use of fire in softening the rocks to enable them to break away the rock from the masses of copper. They knew nothing of drilling or blasting, but used the stone hammer freely. More than ten cart loads of stone hammers were found in the vicinity of the Minnesota mine. One of the larger class weighed 39½ lbs., while smaller specimens weighed 5 or 6 lbs each. These stone hammers have a crease around them, obviously for a withe handle. Such handles are made of tough saplings or small trees, that will bend around the stone and, when firmly bound in their place by strips of strong bark, make a hammer about as effective as a modern blacksmith's sledgehammer. Ashes and wood coals have been found on the rocks at the bottom of the working, showing the use of fire to prepare the way for the effective use of the stone hammer. These mines must have been worked for centuries judging by the extent of the works.

In one place the excavation was about 50 ft. deep, and at the bottom were found timbers forming a scaffolding, and a large sheet of copper was discovered there. In another place in one of the old pits was found a mass of copper that weighed 46 tons. At another point the excavation was 26 ft. deep. In another opening at the depth of 18 ft. a mass of copper weighing over 6 tons was found raised about 5 ft. from its native bed by the ancients and secured there on oaken props. Every projecting point had been taken off, so that the exposed surface was smooth.

Wherever the ancients found copper, from a few pounds weight to a few hundred pounds in weight, they were obviously able to utilize them, but the large masses were too heavy for them to handle. Their habit was to throw the broken stone behind them as they progressed with their works. Many of their workings are 10 ft. or less in depth.

There is a piece of low arable land a few miles from the mines, near what is called the "entry" or place where boats put up a small stream that runs into Keweenaw Bay, that the old miners probably used as their camping ground, for here has been the principal find of ancient tools on Keweenaw Point. These copper tools have been frequently found in the old earthworks in Wisconsin, Ohio and Canada, and the writer thinks that he has read of their being found further south, in the Mississippi Valley. There are no human remains found near the workings nor evidences of human habitations.

Whoever they were, whatever their habits were, many long centuries have passed since they last worked these mines. Their trenches and openings have become filled up, or nearly so. Monstrous trees have grown over their works and fallen to decay, other generations of large trees have grown and perhaps fallen and decayed—how many, no one can tell. All that is known is that when the mines were rediscovered, decayed trunks of large trees were lying over the works, with a heavy growth of live timber then standing on the ground. Over one of these works in the Minnesota mine a hemlock tree showed 395 annular rings.

The masses of copper found in the earlier days have not been equaled in size in later years. In fact, large masses of copper are not as profitable to find, owing to the difficulty and expense of getting them out and cutting them up. Among the numerous masses of copper, the most notable was found in the Minnesota mine in 1857. It was difficult to dislodge it from its native bed. Charges of powder, first of 125 lbs., gradually increased to 550 lbs., failed to dislodge it. Finally a charge of 750 lbs., securely tamped under it, was fired, with the result of lifting from its bed without fracture a mass of copper 46 ft. long, 18 ft. in breadth and 9 ft. thick, the two latter measurements being taken at the greatest distance, the whole mass weighing about 500 tons. In cutting it up 15 tons of chips of copper were made.

The greatest mine for many years has been the Calumet & Hecla. The development of this mine began about 1867. Its works are situated on what is locally known as the Calumet & Hecla conglomerate. This is a vein at its mine of from 6 to 28 ft. in thickness, generally carrying copper interspersed through the rock, with rare exceptions, the larger pieces usually weighing only a few ounces and from that of all sizes down to dust as fine as gold dust. No very large masses of copper have been found, none worthy of notice compared with those before referred to. It is the universality of the small pieces of copper through such a vast quantity of rock that makes the marvelous wealth of this mine, although in their explorations the workmen have found long stretches of rock too lean to be worth milling.

They were fortunate in opening shafts in very rich rock near the surface in their early days, which gave the company its financial strength, enabling it to pay good dividends and push explorations. The shafts extend for about 2 miles along the vein and are 14 in number. Many of the shafts have been sunk to a great depth before finding paying rock. One of the latest explorations descended 2,700 ft. before paying rock was found. All of the shafts have found paying rock when pushed deep enough, and all are richer at their greatest depth than at the surface.

A study of these results, as well as the results at other mines, has led to the conclusion that the most profitable mining is to be found at great depths. The method of mining up to this writing has been to sink their shafts down on the slope of the vein. Captain DANIELL, one of the ablest miners of that country, who has been for years in charge of the Osceola mine, reasoning out the probable course and character of this wonderful vein.

backed by abundant capital, inaugurated a bold and original idea of mining. Selecting a location beyond the lands of the Calumet & Hecla and above the vein, he calculated that a perpendicular shaft should strike the vein at a depth of 2,300 ft. It was a bold enterprise to go out into the open country and lay out the work upon land that showed no indications of copper at the surface and enter upon a labor of years to find a vein of copper, the continuity of which was unknown, except by logical reasoning from the surface openings of the Calumet & Hecla.

What freaks of nature in the bowels of the earth might defeat his logic no man can tell. Patiently year after year the work went on, and at the end of three years and four months the expected vein was found within 30 ft. of the expected depth. The result was the opening of the famous Tamarack mine, which, with other mines now opening by the same men, bid fair to rival the Calumet & Hecla. The Tamarack mine has been in successful operation for 4 years.

Encouraged by this success, a second shaft has been sunk on the same location, which has just come into successful operation. The vein where pierced by these two shafts is of the same general character as that in the Calumet & Hecla. On another location the same company has sunk two shafts to a depth of 2,300 ft., but do not expect to reach the copper until November next at a depth of about 2,500 ft. A third mine of two shafts has been commenced on still another location, that has attained a depth of only 500 ft., but is expected to be sunk about 3,800 ft. before reaching copper.

Within about two years the Calumet & Hecla commenced an enormous vertical shaft, intending to cut the vein on their land at a point below their present workings at a depth of about 3,700 ft. It will take nearly two years before this shaft can reach the vein. It will be interesting to note the result of all these unfinished works. If the calculations of their projectors are not at fault, they will put in the shade all past achievements in copper mining in this country.

The rock is no longer roasted. That method was abandoned years ago. The method is to raise the rock to the surface in such lumps as it is left in by the blast in the mine. Here the large pieces are put through stone crushers, that break it into lumps not larger than a man's fist. It is then dumped into cars, and taken about 4 miles to the border of a small lake, where it is stamped and washed, a process called milling. After the earthy matter is worked out as far as practicable, it is sent to the smelter, where it is cast into the various forms of copper required in the markets of the world.

It is difficult in a few words to give an idea of the magnitude of these operations. The people who live almost together upon the group of mines, of which the Calumet & Hecla is the principal one, number about 12,000, all of whom are either directly or indirectly supported by the mines. About half as many more are supported around the mills and smelting works.

All the mines have to pump the water up to their mills to wash the earthy matter from the copper. The amount of water pumped daily by the Calumet & Hecla to its mill is about 34,000,500 galls., a good supply for a city. A pump nearly completed will throw about 50,000,000 galls. a day.

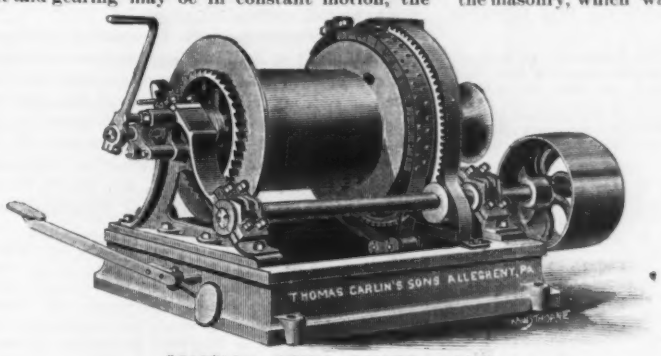
The Calumet & Hecla sends daily to the smelting works about 135 tons of mineral, as the copper is called after stamping and washing, which, when smelted, will produce about 95 tons of pure copper daily. The greatest depth of the Calumet is over 3,000 ft., and the greatest depth of the Tamarack is about 2,850 ft.

The native copper of these mines is the only considerable body of such copper yet found in the world. The character of the mines improves the greater the depth to which they are worked. In this respect this district is different from many others. The Cornwall mines of England, as they went down, gradually changed to tin mines. In Montana the mines are of decreasing value when worked below the water level of the country. The Chilian mines, that once dictated the price of copper for the world, can no longer be worked with much profit and are not a serious factor in the market. The native copper of Michigan has more tensile strength and greater conductivity for electrical purposes than any other. It commands the highest price in the market for its better adaptability for many kinds of manufacturing purposes.

In the deep mining of this country no particular change is noticed in the temperature of the mines as they go down. Water is not encountered in troublesome quantities. The veins seem to be almost hermatically sealed up. These are all favorable conditions for mining. A striking feature of these improvements is the ponderous machinery, engines, pumps, stamps and fly wheel, as fine as any in the world, housed in large brick and stone buildings with iron roofs. Wonderful as the improvements have been, others are to follow. Advanced thinkers are looking forward to the time when electricity will come to their aid to drive their drills and perhaps light these subterranean caverns. The time will also come when a limit will be reached for hoisting by steam power from the surface. When I suggested this difficulty to Capt. DANIELL, his quick response was: "Electricity can be used to bring the ore within reach of a surface hoist." At the suggestion of expense, he said: "That is not a very material factor." His answer suggested big thoughts of future possibilities.

Friction Drum Power Hoist.

The accompanying illustration shows a friction drum power hoist of a convenient type, for use wherever power is obtainable. It is driven by a belt, and the machine is so arranged that while the belt and gearing may be in constant motion, the drum revolves only when the friction lever shown is moved.



FRICTION DRUM POWER HOIST.

When used by contractors and quarrymen, a cat head is placed on the far end of the drum shaft; a powerful foot brake is also furnished, with pawl and ratchet for holding the load in position. When desired, the brake and friction lever may be combined, so that when the load is hoisted, the brake is off, and *vice versa*, when lowered.

A double friction drum power hoist, on the same principle, is also made for quarry and mining uses, either for working two derricks, a load and boom line on one derrick, or for operating a tail rope system of haulage. When built for contractors' uses, a cat head is put on each drum shaft. When used for tail rope system, the two friction levers and two brake levers are combined so that it can be more easily operated by the two handles. Pawls and ratchets can be attached to each drum when used for hoisting purposes.

These hoists, we are assured, are very strong and effective machines, of advantage in many other locations besides those mentioned. They are manufactured by THOMAS CARLIN'S SONS, Allegheny, Pa.

Progress at the "Sodom Dam"—New Croton Aqueduct Supply.

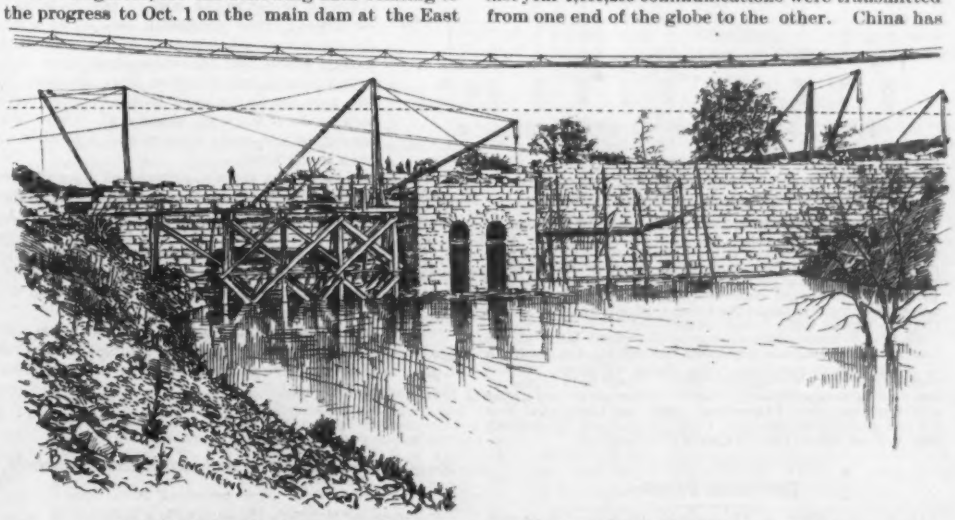
We are indebted to Mr. WALTER MCCULLOH, Assistant Engineer, for the following data relating to the progress to Oct. 1 on the main dam at the East Branch Reservoir, on the Croton River, commonly called the "Sodom Dam":

The view given shows the back of the dam and the gate house, and the dotted line above indicates approximately the level of the finished coping of the dam. This coping will be at elevation 425 (N. Y. City datum), and the lip of the waste-weir at 415; the water level will range from 415 to 419, as stop-planks are or are not used. In the view shown the water level is at 369, 20 ft. above the original river bed and 17 ft. above the sill of the gateway arches.

The length of the dam at coping will be 500 ft., and the length of waste-weir 500 ft. The elevation of the bed of the river is 347, and the bottom of the foundation at the lowest point is at elevation 326.

Work was commenced on the excavation in March, 1888, and by Sept. 1 the foundation was ready for the masonry, which was immediately commenced. On Oct. 1, 1890, the average elevation of the top of the masonry was 407, and the wall contained 29,500 cu. yds., including granite, facing stone, brick and rubble masonry.

All of the material, except rubble-stone and sand, are received on a switch track at the west end of the dam and connecting with the New York & New England Ry. The rubble-stone is teamed from a quarry about one mile distant and is delivered from the east end. The cement and sand are mixed dry in proper proportions at the east end, and the water is added on the wall as the mortar is required. The general plan of this dam, the arrangement of the plant and the system of cable carriage for the handling of the above material, are fully illustrated and explained in ENGINEERING NEWS of Dec. 1, 1888.



PROGRESS AT THE "SODOM DAM," NEW CROTON AQUEDUCT SUPPLY.

The broken line shows, approximately, the coping of the completed dam.

The World's Telegraph Lines.

The length of telegraph lines of the world at the end of 1889 had reached a total of 1,680,900 miles, sufficient to go round the equator 70 times. Of this total, the United States had 776,500 miles of wire, on which, in 1889, no less than 56,000,000 messages were sent. France has 220,800 miles of wire, on which 30,050,000 dispatches were transmitted last year. Great Britain possesses 180,000 miles of telegraph line, and in 1889 sent 50,000,000 messages. Russia has spun out 170,500 miles, and in one year dispatched 10,280,789 missives. Australia has strung across its surface no less than 105,360 miles of wire, and transmitted in 1889 12,000,000 messages. Canada has 58,500 miles, and made an annual record of about 4,027,581 dispatches. Italy owns 19,500 miles, and did a business in 1889 of about 7,000,000 electric messages. Egypt has 5,500 miles, and is in connection with India and England by submarine cables, on which last year 1,000,205 communications were transmitted from one end of the globe to the other. China has 5,500 miles of wire across Mongolia; and Japan owns 16,500 miles, over which 5,000,000 messages were sent in one year. New Zealand has covered itself with 11,375 miles of metal cord, and dispatched 1,835,394 messages. Tasmania has 2,500 miles of telegraph wires. Persia claims, in partnership with European wires, about 6,124 miles. South Africa has a credit of 4,310 miles of wire. There are, besides, 942 submarine cables, exclusive of the 7 Atlantic cables, with an aggregate of 112,740 nautical miles.—*The Engineer.*

Graphic Diagram of Air Compression—Correction.

In the theoretical diagram of air compression (Fig. 1, page 357 of last issue) the numbers necessary to complete the diagram were unfortunately omitted. We print the corrected diagram herewith, and also repeat the part of the text referring directly to it.

The vertical and horizontal lines designate the various measures as registered by the numbers on each side, and at top and bottom. The adiabatic or heat curve commencing at the bottom and left hand passes to the right and upward, showing the amount of compression at any given gauge pressure by the decimal amounts marked across the top of the diagram, and the pressures by at

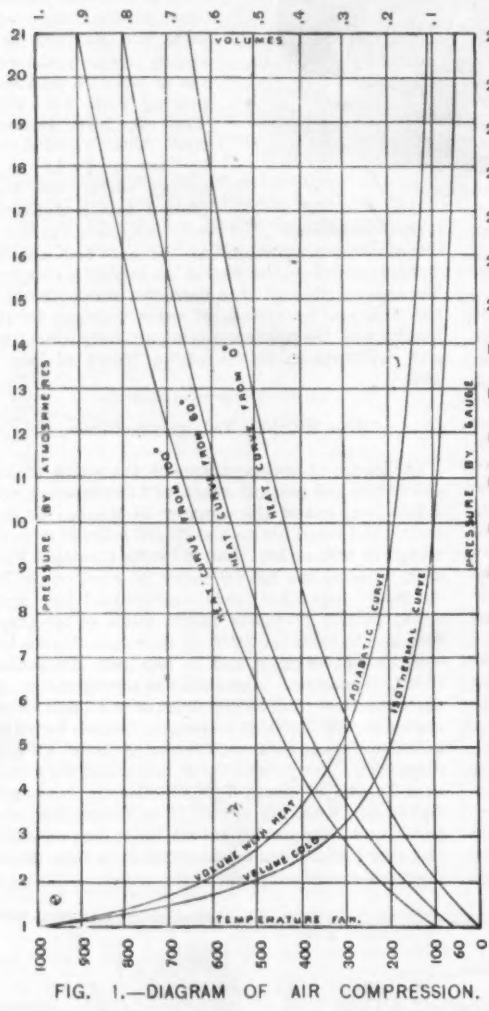

VOLUMES
PRESSURE BY ATMOSPHERES
PRESSURE BY GAUGE
HEAT CURVE FROM 60°
HEAT CURVE FROM 80°
HEAT CURVE FROM 0°
ADIABATIC CURVE
ISOTHERMAL CURVE
VOLUME WITH HEAT
VOLUME COLD
TEMPERATURE FAH.
21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
294. 279. 264. 250. 235. 220. 205. 191. 176. 161. 147. 129 117. 102.9 88.2 73.5 58.8 44.1 29 4 14.7 0.
1000 900 800 700 600 500 400 300 200 100 60 0

FIG. 1.—DIAGRAM OF AIR COMPRESSION.

mospheres by the figured column at the left, and pressure by gauge by the column at the right of the diagram.

The isothermal or cold curve, running also in the same direction and diverging for a part of its course from the heat curve, shows the approximate loss in percentage of volume or the volume when cooled to the normal temperature by the horizontal intersecting lines as read by the decimal proportions across the top of the diagram. These curves represent the theoretical effect of compressing air without the means of cooling the air in the compressor while being compressed.

The three lines commencing at the right hand at the bottom of the diagram represent the actual temperature of compression starting from three different normal points, viz.: zero, 60° and 100° Fah Their indications of the heat of compression for various pressures are noted at the intersection of the curve with the horizontal line for any given pressures and read in degrees by tracing the vertical line to the bottom of the diagram.

Electrical Pranks.

Under the title of "Electrical Pranks," a recent number of *The Engineer* notes some peculiar facts as to the effect of high tension currents for power and light purposes on telephone and telegraph lines. If two wires are stretched side by side but not touching, a current sent through one of them will cause a current to flow in the opposite direction through the other as long as the first current is fluctuating. When this current becomes steady, however, all the inductive effect in the second wire disappears and no current flows. The majority of the dynamos now in use are alternating, or generators of currents, whose electromotive force alternately rises and falls. A current from such a machine is constantly fluctuating, and, consequently, always tends to set up induced currents in other wires.

All Bostonians who use a telephone line in the vicinity of the West End Electric Railway can testify to the annoyance to which the induced currents have subjected them, and the trouble has given rise to almost endless litigation.

It was in connection with the opening of the great Ferranti plant at Deptford that the most remarkable induction phenomena have been observed. The first effect of sending a current through the cable was to render all the telegraphic instruments in the neighboring signal boxes untrustworthy. In the *Journal* of the Institute of Electrical Engineers for August, Mr. PRICE, electrician of the Government telegraph lines, says:

> There is at the present moment a very troublesome source of "foreign currents" in our wires, due to the induction of the high-pressure alternate-current system generating the electric light. A company which has established a central station at Deptford, and which means to distribute currents over London at very high pressure, has given the Post-office very abundant evidence of their presence. Most of our wires to the South of England have, more or less, during the last 6 months been disturbed. At one time the disturbance was very marked indeed, even observable in Paris.

When this heavy current from the Deptford station was sent across London to the Grosvenor Gallery, a telephone central station nearly a half mile distant was rendered useless for a time.

Another remarkable case of induction occurred during the passage of some very powerful currents in Newcastle, when distinct induced currents were perceptible at Gretna Green, 45 miles distant.

Crude Oil vs. Coal.

About two years ago the St. Paul Street Ry. Co. was practically forced to adopt crude oil instead of coal as fuel in the Selby Ave. power-house. But the forcing seems to have been a favor rather than a burden, because the company substituted the oil burners for the grates in the Dayton's Bluff power-house, and are preparing to use oil in the new house being erected on Washington street. Supt. Scott says:

> "The use of oil instead of coal has a number of advantages, although it is just about a stand-off so far as the cost of raw material is concerned. That is, figuring coal at $4 a ton. In the use of oil, however, we do away with smoke, which was the inducement that compelled us to go into its use at first. In using oil two men can do the work that it required three men to do if we were using coal. There is a saving of one man, a team and a fireman at each power-house.
>
> "Of course, there is a certain element of danger from explosion and combustion, but this is reduced if proper precaution is used in handling and storing the oil. At the Selby Ave. power-house we have two brick vaults built, in each of which is a tank capable of containing 15,000 galls. of oil. The vaults are practically fire-proof. At our new house we will dig holes underground in the sand rock, and there will be little danger there.
>
> "It has no bad effect on the boilers, although some people have an idea that the intense heat injures them. Our boilers at the Selby Ave power-house show no more effect than had we used coal."

Employers' Liability and Accident Insurance.

Employers' liability insurance is a somewhat new enterprise that is making steady progress in this country, especially in the South. An incentive is found in the late decisions of the United States Circuit Court, holding vessel owners liable for injuries to sailors arising from defects in rigging, etc. This decision reverses previous rulings and is making ship owners take greater precautions. Elevator insurance is another wide field opened by the constant increase in the already enormous number of these appliances in use, and the fact that the courts now hold owners and lessees of buildings liable for accidents to passenger or employé in the elevator or elevator well, or while entering or alighting from an elevator car.

The insurance premium is moderate, and the insurance system has decided advantages. As the company insuring must pay $5,000 for any single person injured and all legal expenses in case of suit, it is to the interest of the company and their regular practice to have the elevator insured thoroughly inspected by an expert and then regularly thereafter inspect it every two or three months. Careful records are kept, and the owner is compelled to pay heed to the recommendations for repairs or renewals. As a result, the public is protected, the owner is relieved of the constant inspection of his elevators, and the insuring party makes some money, or ought to.

Adopted Designs for Storm Sewers, Duluth, Minn.

(WITH INSET.)

The City of Duluth, Minn., has the separate system of sewerage, the only rainfall entering the sanitary sewers being the roof water, which is estimated at 0.2 cu. ft. per second per acre. The city has an area of 13 sq. miles, 172 miles of streets and 52 miles of alleys. The sanitary sewers were first put in operation in 1886, and on March 1, 1890, there were 15.9 miles of these.

On the above date there were in operation 5.98 miles of storm water sewers, which had cost $161,152. These sewers average about ¼ mile in length, and each discharges separately into Lake Superior, the bay, or large ravines. The grades of these sewers are generally very steep, from 7 to 26%, which should be borne in mind when examining their sections and details as given on the inset in this issue. Up to 24 ins. in diameter the sewers are of vitrified pipe, surrounded by 6 ins. of concrete.

From 34 to 36 ins. in diameter the storm sewers are of Portland cement and concrete, and above 36 ins. they have granite bottoms and sides, and arched brick tops. It will be seen that in connection with the sections of the smaller sewers the length which can be laid with 1 cu. yd. of concrete is stated.

There are no catch basins proper, but there are 281 intakes, consisting of brick inverts from the gutters, which connect with branches leading to the sewers. All débris passes directly to the sewers, which is permissible on such steep grades.

The total cost of these sewers is assessed on the property benefitted.

An International Cable System.

Mr. J. HENNIKER HEATON, Member of Parliament for Canterbury, is now in Canada, and in a long interview with a representative of the Boston *Herald*, he spoke practically as follows of his pet scheme for cheapening cable messages between England and Australia. He says that the average cost of such messages is now $30, and that one message recently sent from England cost $7,000.

He proposes to lay a cable from Vancouver to Australia, by way of Hawaii and Fiji, preferably as a State enterprise by all interests concerned. As laid down, the length of line would be as follows:

Brisbane or Sydney to North Cape	1,300 knots.
North Cape to Fiji	1,240 "
Fiji to Fanning Island	2,270 "
Fanning to one of the Sandwich Islands	1,260 "
Sandwich Islands to Vancouver Island	2,730 "
Vancouver Island to Vancouver City	100 "
Total	8,900 knots.

Mr. HEATON estimates the cost of this 9,000 miles of cable at $10,000,000; and that when connected with the telegraph sytem of the Canadian Pacific Railway and the Atlantic cable to Valencia, it would have a capacity of 10,000,000 words per year, and would produce a revenue of $2,500,000. He says a private company has offered to do the work for a subsidy of $450,000 per year. But as the governments could raise the necessary capital at 3 per cent., the interest charges on the estimated $10,000,000 for construction would only be $300,000 per year, and this would be reduced by the saving of $50,000 in the transmittal of government messages. To carry out this scheme would require the absorption by the government of all existing companies affected, but these only represent $52,500,000 of capital. Many of these lines are old; 180 miles of

them have been submerged 18 years; 2,400 miles, 17 years; 2,724 miles, 16 years, and 1,283 miles 15 years. The 12,035 miles in the Eastern extension could be reconstructed to-day for $11,000,000. Assuming this as a fair purchasing price, the total cost of the new international system would be about $21,000,000.

The interest on the above amount would be $630,000; but the purchase of the Eastern Extension Co.'s business would extinguish subsidies now paid by the colonies annually amounting to $283,500. The Hawaiian Government also offers to further reduce interest account by a grant of $20,000 per annum. Mr. HEATON concludes, therefore, that it is folly to subsidize a private company with $450,000 when the Government can carry on the work for about $300,000 for interest on the investment, and make a possible profit, at reduced rates of $2,000,000 per year.

History of English Weights and Measures.

The jewelers of the Middle Ages used in their delicate scales the hard brown seeds of the Moorish carob tree (*Ceratonia siliqua*), and the weight of diamonds is still reckoned by carats, each carat being equal to 3½ grains Troy. The earliest attempt to regulate British weights and measures appears to have been suggested by this example. In 1266 it was declared by statute that "an English penny, called a sterling, round and without any clipping, shall weigh thirty-two wheat corns in the midst of the ear; and twenty pence do make an ounce, and 112 ounces one pound; and eight pounds do make a gallon of wine, and eight gallons of wine do make a London bushel, which is an eighth part of a quarter." We have here the basis of the British system of reckoning as it survives to-day—the grain, pennyweight, ounce, pound, gallon, bushel and ton, and 240 silver pence equal to a pound sterling. The British gallon is still used for both dry and liquid measure; and the traditional relation between the pound and the gallon, is set forth in the old rhyme, which declares that

"A pint's a pound
The world around."

In 1324 the measures of length were defined by a similar statute, providing that "three barleycorns, round and dry laid end to end," shall make 1 inch, 12 inches a foot, and 3 feet a yard.

The 32 wheat corns, adopted as the basis of the British system, appear to have weighed 22½ grains Troy, so that the pound of 1266 was equal to 5,400 grains Troy. This is the old Saxon pound. The pound Troy (pound *du roy*) is the Roman pound, and was, doubtless, in use simultaneously with the Saxon pound for hundreds of years, but is first mentioned in the statutes in 1414, and was ordained as the standard weight for gold and silver in 1527. As 24 grains make a pennyweight Troy, the new pound contained 5,760 grains, exceeding the old weight by 360 grains, or three-quarters of an ounce.

The strict pound of 12 ounces was used only in weighing the precious metals, and, with different subdivisions, for the costly drugs and medicines dealt out by apothecaries. For heavy goods (*avoirs du poids*) a more liberal measure was given, like the baker's dozen, and 15 ounces were called a pound. In the same way 28 lbs. were called a quarter and 112 lbs. a hundredweight, allowance being made for waste or wrappings. The increase of the pennyweight to 24 grains in 1527 raised the value of the ounce to 480 grains, and accordingly the pound of commerce, containing 15 ounces, was raised to 7,200 grains. As 250 grains of wine were reckoned equal to a cubic inch, the gallon, containing 8 of these pounds, or 57,600 grains, had a capacity of 230.4, or in even numbers 231 cu. ins. This is the wine gallon now in use in the United States. The ale or beer gallon, of 282 cu. ins. was originally a measure containing 8 lbs. of wheat at 304 grains to the cubic inch.

The name avoirdupois was transferred at a very early date from the heavy goods, which it indicated, to the system by which they were weighed. It occurs first in the statutes of 1335 and 1353. The early pound of 15 ounces of 450 grains each—6,750 grains—was raised by law as has been shown, to 7,200 grains, making 16 of the old ounces. In practice however, the pound seemed to have fallen below this standard to about 7,000 grains, and this weight was finally declared to be a pound avoirdupois, the avoirdupois ounce, or sixteenth of a pound, being thus reduced to 437½ grains.—*From "Metric System," by H. W. Richardson, in Harper's Magazine for September.*

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Clarendon & Pittsford.—The extension of this road to Rutland is being rapidly constructed.

Maine Central.—Work on the Coös Valley R. R. is making rapid progress. The grading has been completed to Lancaster, N. H., and track has been laid to Jefferson Mills, N. H.

Cincinnati, Wabash & Michigan.—The heavy work on the extension from Anderson to Rushville, Ind., is progressing favorably, and if the weather is favorable but a short time will be necessary to complete the road. All but 14 miles of the track have been laid, and this, it is expected, will be completed by Nov. 1.

Pennsylvania.—A press dispatch from Boston, Mass. dated Oct. 16, says:

A conference was held here to-day between several Philadelphians interested in the extension of the Pennsylvania roads into New England and certain Boston capitalists in reference to the sale of the Meriden, Waterbury & Connecticut River R. R. and the building of an extension from Meriden to Hartford and New Haven.

Cleveland, Lorain & Wheeling.—This company will, it is stated, build a line from Medina, O., to Cleveland, O. Surveys are now in progress, and the road is to be completed by next spring.

Toledo, Columbus & Cincinnati.—This company has completed arrangements to build a railway from Kenton, O., to a connection with the Cleveland, Cincinnati, Chicago & St. Louis R R., at Marysville, O. Construction is to commence at once, and the road will be pushed rapidly to completion.

New York Central & Hudson River.—This company has in contemplation important improvements on its lines between Syracuse and Buffalo, N. Y. The improvements will consist mainly of removing heavy grades and curves.

Barre.—A branch of this road is being built from the quarries to East Barre, Vt., a distance of 1¼ miles.

Projects and Surveys.

Moosilauke.—F. W. Conn, of Concord, N. H., Chief Engineer, is now making another survey for this New Hampshire railway. The road as projected will run from a point on the Concord & Montreal R. R. to the summit of Mt. Moosilauke. The maximum grade of the road will be about 4%.

Hopatcong, Caldwell & New York.—This is the name of the proposed road projected to run from Caldwell to Great Notch, N. J.

Skowhegan & Norridgewock.—The Maine Central R. R. Co. has made an offer to rent this road when completed, and to guarantee the bonds of the company. The road is to run from Skowhegan to Norridgewock, Me.

Toronto, Hamilton & Buffalo.—Chief Engineer E. B. Wingate is now buying the right of way for this Canadian railway.

Farmington & Gardiner.—A charter will be asked of the Maine Legislature to build a railway from Gardiner to Farmington, Me., a distance of 35 miles. The road will be very easy to construct.

Frederick & Monocacy Valley.—C. L. Hartsock, of Frederick, Md., writes:

This railway is projected to run from Catoctin Furnace, Md., via Lewiston and Montonqua Springs to Frederick, Md., a distance of 13 miles. The surveys are nearly completed, and a favorable route has been secured. The road will pass through a thriving section of the country. The company will build the road itself.

Deerfield Valley.—A bill has been introduced into the Vermont legislature to incorporate a railway company by this name.

SOUTHERN.—Existing Roads.

Norfolk & Western.—A correspondent writes as follows:

The track on the Clinch Valley Division is now being laid through the Big Bull, Little Bull and Holbrook tunnels to trestle No. 56, 86 miles west of Bluefield, on the New River Division. This trestle is now being erected by the contractor, W. F. Patterson, and will, it is expected, be completed by Nov. 15. Tracklaying will then be pushed rapidly to Norton, Va., where connection is made with the Louisville & Nashville R.R. The entire line to Norton will probably be completed by December. The principal contractors are: Geo. T. Mills and Sexton & Houston. The latter firm is also building the Coal Creek Branch, a short distance west of Doran, Va. This branch will open up extensive deposits of gas coal. A market for this coal has already been found in New York City by Perkins & Co.—Considerable progress is being made on the Russel Creek Branch by the contractors, L. H. Vaughan, Roanoke, Va. This branch reaches the gas coal deposits now being opened by the McQuail Coal & Coke Co. The vein being worked by this company is over 8 ft. thick. The coal from these mines will form a considerable portion of the traffic of the Clinch Valley Division.

Columbia, Newberry & Laurens.—An extension of this road from Clinton, S. C., to Rabun Gap, N. C., is talked of.

East Tennessee, Virginia & Georgia.—This company is reported to have secured control of the East Tennessee & Western North Carolina R. R., and will, it is stated, extend it from Cloudland to Roan Mt., N. C.— Surveys are reported in progress for a line from Childersburg to Montgomery, Ala., 75 miles.

West Florida & Alabama.—J. D. Perrong, of Wewahitchka, Fla., writes us as follows:

This road is projected to run from Chipley, Fla., to St. Andrew's Bay, St. Joseph and Apalachicola, Fla., a distance of 150 miles. The surveys have been completed, and the contract let to the St. Andrews Construction & Improvement Co. About 45 miles have been graded, and tracklaying will begin about Jan. 1, 1891. The principal business will be in lumber, oranges, fish and minerals. J. M. Withrow, of Chipley, is Chief Engineer.

Projects and Surveys.

Alabama, Georgia & Florida.—A correspondent writes us that this company has not been organized, and that no steps will probably be taken to build the road until after Christmas.

Escambia.—This road is projected to run from Sullivan to Monroeville, Ala., with a branch to Wallace, Ala. M. H. Sullivan, Pensacola, Fla., is President.

Stevenson, Sand Mt. & Dalton.—Two surveys have been made for this Alabama road. One from Birmingham to Bridgeport, Ala., 102 miles, and the other from Stevenson to Dalton, Ala., 50 miles.

Tarpon Springs & Tampa.—This company has applied for a charter to build a railway from Tarpon Springs to Tampa, Fla. As soon as the charter is obtained it is stated that surveys will be made and construction begun.

NORTHWEST.—Existing Roads.

Northern Mississippi.—E. T. Abbott, of Minneapolis, Minn., Chief Engineer, writes as follows:

This railway is 16 miles long, and is located in Cass Co., Minn. The grading has been completed and 6 miles of track laid. The road is standard gauge, and will be used entirely in hauling timber. All the steel and cars and material were hauled 14 miles to the railway by teams.

Escanaba, Iron Mountain & Western.—Surveys are in progress for an extension of this railway from Escanaba to Ishpeming, Mich.

Kickapoo Valley & Northern.—At a meeting of the directors recently held it was voted to increase the capital stock of this company to $1,600,000, and to push work on the construction of the line from Wauzeka to Wilton, Wis.

Chicago, Rock Island & Pacific.—The bridge across the Platte River has been completed and 20 miles of the line between Papillion and South Bend, Neb., finished. Work is making rapid progress and the entire line between Omaha and Beatrice, Neb., will be completed by Nov. 15.

Port Arthur, Duluth & Western.—It is expected to have this railway completed from Port Arthur, Ont., to a connection with the Duluth & Iron Range R. R. at Ely, Minn., within a year. Construction is being pushed on the division to the International boundary which is to be completed this season. Surveys are in progress for the section from the International line to Ely.

Milwaukee, Lake Shore & Western.—A correspondent writes that work on the branch from Interior Junction to the Duluth, South Shore & Atlantic R. R. will not commence for some time. The road will be used for logging purposes only.

Forest City & Southeastern.—Surveys have been commenced for the proposed extension from Forest City to Rapid City, S. Dak.

Projects and Surveys.

Duluth, Red Lake Falls & Northern.—A correspondent writes us that the preliminary surveys are in progress for this Minnesota road. Several lines are being surveyed from Red Lake Falls, Minn., both north to the International boundary and east to Duluth.

St. Louis & Superior Terminal.—Chartered in Minnesota to build a railway from Fond du Lac, Minn., to West Superior and to Old Superior via South Superior. Among the incorporators are: N. J. Upham, A. C. Otis and Orlando J. Brice.

Chicago & New Orleans.—This company has decided to commence work at once and to have about 30 miles completed by Christmas.

Chicago & Skagit Valley.—The contract is reported let for the portion of this railway crossing Whidby Island. This section of the road will be 25 miles long. The location of the remainder of the line, which is to run from Admiralty Bay, Wash., across Whidby Island to La Conner, and thence up the Skagit Valley to Sauk, Wash., is in progress. W. J. Croken is Chief Engineer.

Colorado, Utah & Pacific.—It is stated that the money necessary to build this railway has been secured, and that contracts will be let soon. The road is projected to run from Denver, Colo., to Boulder, Colo., crossing the Continental Divide at Buchanan's Pass, and thence to Steamboat Springs, Colo., and Salt Lake City, Utah. The road will be 449 miles long. There will be a 3,000-ft. tunnel on the line. Surveys have been completed. Jas. McLean is President.

Burlington & Missouri River.—Engineers are making preliminary surveys for the proposed extension from Oberlin, Kan., to Pueblo, Colo. The survey has already been completed from Oberlin to Rocky Fork, on the Arkansas River, and is now in progress between the latter place and Pueblo.

SOUTHWEST.—Existing Roads.

St. Louis & Hannibal Short Line.—About $100,000 will be expended in improvements on this line. These improvements will include shops at Hannibal, Mo., 10 miles of steel rails, two new locomotives, and new coaches, baggage and freight cars. It is also stated that the road will be extended through Custer and Perry to a connection with the Wabash R. R. Preliminary surveys for this extension will begin at once.

Chicago, Kansas City & Texas.—The money to build this road has been secured, and work will begin at once. The line will be built from Smithville, Mo., north a distance of about 175 miles.

St. Louis, Arkansas & Texas.—The Missouri division of this road has been sold by the Master of Chancery to a reorganization committee of the bondholders for $6,000,000.

Atchison, Topeka & Santa Fe.—This company will open its Chicago-St. Louis line on Nov. 16. The new line will run from Chicago to Pekin over the Atchison line, thence to Sorrento over the Jacksonville & Southeastern, and thence into St. Louis over the Toledo, St. Louis & Kansas City and Merchants' Bridge Terminal. The new line is 333 miles long, against 282 by the Alton, 286 by the Wabash and 299 by the Illinois Central.——A report is in circulation that the company will extend its line from Kansas City, Mo., to Memphis, Tenn., paralleling the Kansas City, Ft. Scott & Memphis R. R.——It is also reported that preparations are being made to build the Eastern Division of the Atlantic and Pacific R. R. from Sopulpa, Ind. Ter., to Albuquerque, N. Mex.

Gulf, Brazos Valley & Pacific.—Grading has been completed on the section from Milsaps to Mineral Wells, Tex., and track will be laid soon.

Projects and Surveys.

Magnolia & Southern.—Chartered in Arkansas to build a line of railway from Magnolia, Ark., to the Louisiana State line, a distance of 25 miles. Among the incorporators are: John Green, J. M. Whaley, T. J. Elmore, President, and E. Elmore, General Manager, all of Magnolia, Ark.

St. Louis, Collinsville & Carondelet.—Chartered in Illinois to build a belt line railway at St. Louis, Mo. Among the incorporators are: A. M. Powell, H. S. Merrill, and E. G. Gerding, of Collinsville, Ill.

Taylor, Georgetown & Western.—The necessary 5% of the capital stock has been raised and the charter for this company will be secured at once. The road will run from Taylor, Tex., to a connection with the Austin & Northwestern R. R. A. O. Doak, of Taylor, is President.

Magnolia & Winden.—Chartered in Arkansas to build a railway from Magnolia into timber lands. The road will do a logging business only.

ROCKY MT. AND PACIFIC.—Existing Roads.

Rio Grande Western.—Work on the branch from Thistle to Manti, Utah, is making rapid progress. Twenty-one miles of brick have already been laid, and it is expected to have the remaining 39 miles completed by Dec. 1.

Denver & Rio Grande.—Work on the Rio Grande Junction R. R. is much delayed by the inability of the company to obtain rails. It is hoped to have the line completed by Nov. 1.

Atchison, Topeka & Santa Fe.—It is reported that this company has secured control of the proposed railway from Alagondes, N. Mex., to Durango, Colo. Preliminary surveys have just been completed for the line and a favorable route is reported to have been secured. The total length of the road will be about 170 miles.

Union Pacific.—Mr. H. V. Gates, Resident Engineer of the Union Pacific, who recently returned from a trip of inspection along the Seattle branch, says:

Work is being pushed in a lively manner, and 20 per cent. of the grading between Portland and Seattle is completed. The heavy fills across the low lands along the Columbia are progressing finely and will be completed before there can be any trouble from high water. The force employed is constantly being increased, and it is intended, if possible, to have 6,000 men on the line.

Work on the Pioche extension has been stopped.—Surveys are in progress for a line from Farmington, Wash., to Clear Water.

Seattle, Lake Shore & Eastern.—The grading is nearly completed on the line north to the International boundary. Tracklaying and bridging is now all that remains to be done. Work is being pushed on these.

Astoria & South Coast.—This company has sold $3,000,000 of bonds in London, England. The proceeds will be used in building its proposed line.

Utah Central.—John W. Young, of Salt Lake City, Utah, President, is reported as saying that 120 miles of this company's lines would be in operation by March, 1891. About 75 miles have already been completed.

Great Northern.—In a recent interview President Jas. Hill is reported as saying:

Our engineers are now in the field, operating along the Columbia in Washington and between Seattle and Portland. Our idea of a road is one from the Fraser river, in British Columbia, to Portland, striking the main line on Puget Sound. We can, I think, make a shorter line by way of Spokane Falls, coming into Portland over the Union Pacific. That would make the distance from St. Paul to Portland 1,850 miles. The Fairhaven & Northern, running from Fairhaven north to the Fraser river, at New Westminster, and the Fairhaven & Southern, running south to Skagit, now belong to us, but the ransfer will not take place until the work of construction is finished, which will be about Jan. 1, 1891. The Seattle & Montana runs from Seattle north, connecting with the Fairhaven & Southern. That gives us a line from Seattle to the Fraser river, and we are now trying to find a line from Portland to Seattle No route has been selected yet through the Cascades. We have examined a number of passes, but must exhaust that question before determining. So far the Snoqualmie has been found to be the lowest pass. Its altitude at the highest point is about 2,800 ft. We are to have a steamship line to Japan. The vessels will be ordered this winter. The number of them depends upon other matters. To make the line what it should be 5 vessels would be required. They will be new ones and as fine as any afloat.

The Fairhaven & Northern R. R. will be completed between Ferndale and Blaine, Wash., about Dec. 1. The section from Fairhaven to Ferndale was opened for traffic Oct. 6.

Cheyenne & Northern.—Tracklaying is progressing on this railway at the rate of 2 miles per day and it is expected to have the line completed by Nov. 1,

Projects and Surveys.

Pacific, Chehalis & Eastern.—It is stated that this road will be built from Willapa Harbor to Chehalis Wash., within 18 months.

Southwestern.—Arrangements are being made to build this road from Pomona to South Riverside, Cal. John Watson, Chino, Cal.

Santa Monica Surf Line.—Thos. J. Rask, of Los Angeles, Cal., Chief Engineer, writes as follows:

This road is projected to run from Santa Monica, Cal., to Ballona Harbor, a distance of five miles. The surveys have been completed and contracts will be let at once. The work will be light; maximum grade 0.5% and maximum curve 4°. The principal business of the road for the present will be the passenger traffic, but as soon as the harbor is completed a considerable freight business is expected. All of the right of way has been secured. The company was chartered Oct. 1, 1890. J. Campbell is President and George Engle is Secretary and Treasurer; office U. S. Hotel, Los Angeles, Cal.

Los Angeles & Eastern.—T. J. Rask, of Los Angeles, Chief Engineer, writes as follows:

Surveys for this line, which is projected to run from Los Angeles to Kramer, Cal., and thence northwest, will be resumed during the spring and summer of 1891. The work will be quite easy; maximum grade 2¼% and maximum curve 8°. There will be two tunnels, 4,000 ft. and 1,800 ft. long respectively. T. J. Cuddy is President.

Prescott & Northwestern.—Chartered to build a railway from Prescott, Ariz., northwest. W. O. Tomkins, President.

FOREIGN.

United States of Colombia.—A correspondent sends us the following concerning railway construction in this country:

It is probable that the contract for the line from Buenaventura, on the Pacific Coast, to Cali, in the State of Canca, will be let to a Mr. Cherry, of Chicago, Ill. A railway is being constructed from Bogota to Zipacuara to open up salt mines at the latter place. The Government of Antioquia is making improvements on the railway from Puerto Berrio to Pavas, and the location of the Cartagena Calamar Ry. is being pushed under the direction of Chief Engineer Tobias. Construction is also progressing rapidly on the Santa Marta Ry.

Montreal & Western.—A correspondent writes as follows: Track is laid on the first ten mile section, and was inspected on Saturday, Oct. 18 by Messrs. Ridout and Vallee, Dominion and provincial government engineers. Work on the second section from Strawbridge to the Ste. Adele is well advanced and the track will probably be laid before the end of the year. The force now employed is 616 men, 230 horses and one locomotive. This road is to run from St. Jerome the present terminus of a branch line of the C. P. R. to La Chute aux Iroquois on the Riviere Rouge, a distance of 70 miles. H. J. Beemer is Managing Director and G. H. Garden is Chief Engineer.

CITY TRANSIT.

Electric Railways.—New lines are proposed in the following cities: Matteawan, N. Y., address W. H. Mase; Long Branch, N. J., address R. P. Dobbins; Lynchburg, Va., address the Virginia Power, Light & Construction Co.; Albama, Ga.; between Rockland and Camden, N. C.; Knoxville, Tenn., address Knoxville Street Ry.; Los Angeles, Cal.; Passadena, Cal.; Oakland, Cal., address M. J. Keller.

Salem, Mass.—The Naumkeag Street Ry. is reported to be putting in an unusually fine plant costing $300,000. The company will run a 30-ft. car with separate ladies' and smoking compartments.

Easton, Mass.—The double trolley system has proved unsuccessful on the Essex Electric Ry., and will be abandoned in favor of the single trolly.

Boston, Mass.—The *Electrical World* reports the probable construction of a storage battery line from Winthrop to East Boston.

Syracuse, N. Y.—The Syracuse Consolidated Street Ry. has received permission to lay double tracks through parts of Onondaga.

Richmond, Va.—The electrical railroad and franchises of the Southside Land & Improvement Co., and the property of the Richmond & Manchester Railway Co., have been consolidated, and the latter company reorganized, with A. H. Rutherford, of Baltimore, Md., President. The capital stock is $300,000.

Greenville, S. C.—E. A. Buck is reported to have organized a $300,000 stock company to construct an electric railway.

Anderson, S. C.—The Western Carolina Land & Improvement Co. is said to be planning a 36-mile line to a new town it will found.

Anniston, Ala.—The Anniston Street Ry. will experiment with storage batteries, and adopt the system if found satisfactory.

Champaign, Ill. A company is being formed to build a storage battery line from this place to Urbana City.

St. Louis, Mo.—Two more companies have applied for electric railway franchises, making four applications now before the Council.

Lincoln, Neb.—The Lincoln Street Ry. has received permission to use electricity on its lines, and will put in a $300,000 outfit.

Sacramento, Cal.—The Central St. Ry. has been purchased by J. H. Henry, of San Jose, who will extend the lines, at present four miles long, and introduce electric motive power.

Cable Railway—***Tacoma, Wash.***—The Peninsula & Electric Cable Ry. has received permission to build a cable line in the western part of the city.

Horse Railway—***Georgetown, Ky.***—The Georgetown Street Ry. will probably lay 4 miles of track.

Cedartown, Ga.—J. H. Allen and associates have a franchise for constructing a street railway operated by electric, steam or horse power.

Gainesville, Tex.—The Gainesville Street Ry. will begin a 3-mile extension on Nov. 1.

San Francisco, Cal.—The Market St. R. R., the City Ry., and the Geary St., Park & Ocean R. R. have petitioned for permission to extend their lines over a large number of streets.

Alexandria, Va.—Richmond exchanges state that the construction of a line to be known as the Alexandria & Fairfax Ry. is probable. It is not yet known whether horse or electric power will be used.

Hammond, Ill.—A new street car line between Hammond, Hegewisch, Whiting, West Hammond and South Chicago is proposed and application for ordinances made. M. M. Towle is connected with the enterprise.

Mountain Railway—***North Conway, N. H.***—A newspaper exchange states that surveys are nearly completed for a railway from North Conway to the top of Mount Kearsarge.

Inclined Railway.—***Seattle, Wash.***—Plans for the incline of the Seattle Electric Ry. are being prepared by Richard Nevins, Jr. The incline will be 1,500 ft. long and have a 17% grade. The plan is to run a cable around electrically-driven drums at the top of the hill and to attach dummies to the two ends. To these dummies the cars will be attached when they reach the hill, and one car will run up the hill while the other runs down, so that the descending car will aid in hauling up the ascending car. The overhead wires will be continued up the incline, as they will be needed when the cars reach the top to carry them onward. The cars on the incline will have trolleys to take the current, though the cable will be the chief reliance. A friction brake worked by levers will be used to regulate the speed, and the dummies will each be provided with two sets of safety brakes, so that there will be every precaution against the cars getting beyond control. Similar inclines have been in operation in Pittsburg for many years.

New Companies.—South End Electric Ry., Chicago, Ill.; capital stock, $100,000; incorporators, F. H. Dyche, C. J. Wood, C. E. Loos. Spokane, Wash., Electric Ry.; capital stock, $100,000; incorporators, W. M. Byers, W. H. Lynch, H. J. Cook. Consolidated Street Ry., Oakland, Cal.; capital stock, $1,000,000; incorporators, J. W. Coleman, G. W. McNear and others.

The Rae Electric Railway System, which was used on the Highland Park Electric Ry., at Detroit, one of the first lines in the country, in 1884, has been developed by its designer, F. B Rae, until it is now in a very complete state. The system uses a single motor of from 30 to 50 HP. hung in the center of the truck and geared by a countershaft to both axles.

Dummy Railways—***Clifton Forge, Va.***—The Clifton Forge Co. proposes building a 2-mile dummy line.

Catoosa Springs, Ga.—Thompson, Hall & Winn, Chattanooga, Tenn., are surveying a 3-mile line from Catoosa Springs to the line of the Western & Atlantic R. R.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Willimansett, Mass.***—Bids are asked for constructing the masonry and foundations of a bridge over the Connecticut River at this place. Hampden Co., Commissioners, Springfield, Mass.

Michigan Central R. R.—The bridge over the Kawkawlin River will be replaced by an iron structure.

Detroit, Mich.—Soundings are being made by the Michigan Central R. R. for a bridge over the Detroit River.

Richmond, Va.—A viaduct is projected to be constructed over Broad St., to cost $500,000.

Chattanooga, Tenn.—The piers have been completed for the bridge across the Tennessee River at this place.

Milwaukee, Wis.—Bids will be received until Oct. 31 for constructing a bridge across Milwaukee River. C. F. Pfister, President Milwaukee & Whitefish Bay Ry. Co.

Lyons, Ia.—The Chicago Bridge & Iron Works, which has the contract for the bridge across the Mississippi River at this place, is pushing work. The total length, including approaches, will be 2,682 ft. The bridge will be

built of steel, in 5 spans, resting on 4 piers and two abutments of stone masonry. The channel span will be 50 ft. above high water mark. The width of the driveway will be 20 ft., exclusive of the 5-ft. side walk The Fulton approach will be 200 ft. long and the Lyons approach 700 ft. Work has been commenced, and the first courses of rock on the piers on the Illinois shore are being laid, while piles are being driven for the pier foundations in midstream. The construction will cost $90,000, of which $30,000 will be paid by the city of Lyons and the balance raised by stock subscription. The contract calls for the completion of the work by April 1, 1891.

Pitts Ferry, Tex.—A bridge to cost $20,000 is to be built across the Brazos River at this point.

Oakland, Cal.—Designs are being prepared for an iron and steel drawbridge across Park St.

WATER-WORKS.

NEW ENGLAND.

Pittsford, Vt.—A bill has been introduced in the Legislature to incorporate a company to supply this place with water.

Bristol, R. I.—The Rock Springs Water Co. has projected works. The town has been supplied since 1882 by the Bristol-Warren Water-Works Co.

Putnam, R. I.—The fire district has authorized the company to set 7 additional hydrants.

Woonsocket and Manville, R. I.—Byron C. Cook, Superintendent, has sent the following:

The extension to Manville will require about 2½ miles of mains. Work will not be started till next spring. Manville is in the town of Lincoln.

MIDDLE.

Rochester, N. Y.—Conesus Lake is now being discussed as the source of the new supply.

Syracuse, N. Y.—The opposition against taking water from Skaneateles Lake still continues, but, notwithstanding, parties are out making surveys for the city.

Montclair, N. J.—At a meeting of the legal voters of the township, held Oct. 23, it was decided that no action be taken to purchase the works of the Montclair Water Co. under the option which expires Dec. 1. The present contract with the company extends 7 years from Dec. 1. Less than 20 citizens were present of a total of some 1,700 voters.

Hempstead, N. Y.—The Hempstead Water Co. has increased its capital stock from $20,000 to $60,000.

Allegheney, Pa.—Contracts have not yet been awarded for the improvements recently advertised. This is owing, in part, to the uncertainty as to whether a large reservoir will be built or a filtering plant put in.

SOUTHERN.

Stanley, Va.—We are indebted to the Stanley Furnace & Land Co. for the following:

The company is building a gravity system at a cost of about $10,000. Water is taken from springs on a mountain.

Tarborough, N. C.—Bids for pumping machinery and other improvements are wanted. Address I. N. Cox, 16 Fifth St., S. E., Washington, D. C.

Charleston, N. C.—The company will sink another artesian well.

Buena Vista, Ga.—The following is from W. D. Crawford, Mayor:

The town talks of building works, but nothing definite has been decided. Water will probably be pumped to a tank at a cost of from $5,000 to $10,000.

Cedartown, Ga.—Works will be built by Col. Barton and others.

Opelika, Ala.—Pumps will be used. Address B. K. Collier or N. L. Wright.

Cattlesburg, Ky.—The town has contracted for works, according to reports.

NORTH CENTRAL

Cincinnati, O.—It is reported that a new 6,000,000-gall. pumping engine has been recommended.

Columbus, O.—Bids for the construction of brick work of boiler settings for two batteries of boilers will be received until Oct. 31.

Van Wert, O.—Attention is called to the advertisement in our "Proposals" columns for the material and labor needed for complete pumping works. John W. Hill, Cincinnati, O., is Engineer.

Madison, Ind.—Proposals, as advertised in our "Proposals" columns, are wanted for a brick infiltration well.

Belleville, Ill.—The business men of the place talk of organizing a company to build new works. The projected supply is from the Mississippi River, by pumping to reservoirs on the bluff west of the city. Works were built here in 1885 by the City Water Co., since when two water famines have been reported, the latter of which we noted last week.—It is rumored that the new works may be built either to connect with the present works of the East St. Louis Water Co. or that a new pumping plant and new reservoirs may be built conjointly with the latter company.

Centralia, Ill.—The city is investigating sources of supply, and is now considering driven or artesian wells. Address Mayor Rhodes.

Duquoin, Ill.—The Duquoin Water-Works Co. are drilling wells for their supply. Pumps will probably be used. J. A. Truesdale is Manager.

Elmhurst, Ill.—The Elmhurst Spring Water Co. has been incorporated with a capital stock of $50,000.

Hudson, Mich.—The new works have been satisfactorily tested.

NORTHWESTERN.

Algona, Ia.—Freemont Turner, Engineer, informs us that construction is under way.

Emmettsburg, Ia.—The works were tested and accepted by the town Oct. 17. They were built by the town with Fremont Turner as Engineer and Contractor.

Hamburg, Ia.—E. A. Rudiger and S. J. Kennedy, Nebraska City, Neb., have secured the contract for constructing the works.

Humboldt, Ia.—The following is from Fremont Turner, Engineer and Contractor:

The works will be put in operation in December. The supply is pumped from a spring to a reservoir. Cost $7,000.

Sioux City, Ia.—D. A. Decrow has reported upon the present condition of the pumping station and the works in general, and recommends that no additions be made to the present plant. When improvements are made he recommends that a 10,000,000-gall. pumping station, with settling basins and a storage reservoir, be constructed on the Missouri River, about three miles above the city. The present supply is from a large number of driven wells, and it is said to be becoming inadequate.

Beloit, Kan.—The Beloit Light & Water Co. has been incorporated, with a capital stock of $7,000.

Ellsworth, Kan. (Grand Army Reunion Grounds.—Bids are asked until Nov. 15 materials and labor for waterworks. There will be a dug well. Plans and specifications can be seen at the office of H. M. Hadley, 627 Kansas Ave., Topeka, or can be secured by addressing Ira F. Collins, Sabetha.

Hebron, Neb.—The city offers for sale, until Nov. 3, $25,000 of 5-20 5% water bonds. F. C. Hensel is City Clerk.

Sturgis, S. Dak.—Peter Milbeims, City Auditor, has sent us the following:

The town has granted to Albert H. Harris and others the right to construct works, but the privilege has not yet been accepted. The same parties have the right to construct and operate electric lights and a street railway. Population, 1,200.

Fargo, N. Dak.—The contract for material and labor for water-works extensions has been awarded to W. D. Allen, Fargo, for $1 ,900.

Larawie, Wyo.—New works or improvements to the present works, which are owned by the Union Pacific Ry., are being discussed by the members of the Board of Trade and by other citizens.

SOUTHWESTERN.

Ballinger, Tex.—Bids for the construction of works will be received by the city until Jan. 1, 1891. Address B. S. Taylor, Mayor.

Hallettsville, Tex.—The contract for construction has been awarded to Guido Jaeger, Rich Hill, Mo.

San Angelo, Tex.—The works are to be remodeled and improved, and bids are asked until Nov. 10 for that purpose. See "Proposals" in our advertising pages.

PACIFIC.

Aberdeen, Wash.—The city has voted to issue $65,000 of water bonds for the establishment of works. A reservoir will probably be built.

Santa Cruz, Cal.—The new works, built by the city, have just been completed. Works were built here by the the Santa Cruz Water Co. in 1876. The city tried to buy the old works, but could not make satisfactory terms.

Ukiah, Cal.—The Ukiah Electric Light, Water & Power Co. has been incorporated with a capital stock of $50,000.

CANADA.

Galt, Ont.—Bids for the construction of a complete water-works and for the construction of the same in two sections will be received until Nov. 17. See "Proposals" columns for details. Willis Chipman, Toronto, is engineer.

ARTESIAN WELLS.

Charlotte, N. C.—It is reported that W. N. Failing and others will organize a stock company and sink an artesian well.

Pass Christian, Miss.—It is stated that an artesian well is being sunk.

Pottsborough, Tex.—W. D. Welden wishes to purchase machinery for sinking artesian wells.

IRRIGATION.

Nebraska and Wyoming.—The Belmont & Froid Canals and Reservation Co. has been incorporated in Nebraska to construct and operate a canal beginning on the south side of the North Platte River, in Laramie Co., Wyo., and extending east into Scott's, Bluff, Bonner, Cheyenne and Deuel Cos., Neb. The projected length of the canal is 230 miles, not including branches, and it is estimated that it will water 635,000 acres. A. M. Van Auken, Denver, Col., represents the company.

Clear Creek Co., Col.—Edward L. Rogers, of Denver, has made surveys for a canal to be built by the Berthoud Pass Canal Co. across the mountains at Berthoud Pass, which lies between Grand and Clear Creek Cos. The scheme includes a tunnel a half mile in length. The tunnel will have an interior cross-section 5 ft. square.

Rocky Ford, Col.—A press despatch from this place states that a ditch will be built to irrigate several thousand acres of land on the north side of the Arkansas River, above Catlin. John A. Thacher, of Pueblo, is interested.

Roswell, N. M.—A well is to be sunk 1,000 ft. or more in search of water for irrigating purposes. Geo. W. Hale will do the work.

Los Angeles, Cal.—The Bear Valley & Allesandro Development Co. will build a storage reservoir sufficiently large to irrigate 100,000 acres.

Idaho.—The Alturas Land & Irrigation Co. was incorporated April 7, with a capital of $500,000, and on Sept. 27 increased its capital to $1,000,000. Wm. Babcock, Jr., Salt Lake City, and John Condron, Hailey, Ida., are among the directors, and George Livings, of Chicago, is the Chief Engineer. The company proposes to build a dam across the Snake River, and to construct canals leading from the river on both sides into Cassia and Logan Cos. It is proposed to irrigate 500,000 acres of land at an estimated cost of $6,000,000.

SEWERAGE AND MUNICIPAL.

Sewers are proposed in the following cities: Portsmouth, N. H.; Hartford, Conn., 12 in. tile; Pittsburg, Pa., 15-in. pipe; Columbus, O., 12-in. pipe and 4½-ft. brick.

Toronto, Ont.—The City Council recently ordered a large number of sanitary sewers.

Buffalo, N. Y.—Assessment rolls for a number of 12-in tile and 7½, 7, 6¾, 6½, and smaller sized brick sewers have been prepared.

Bristol, Pa.—Sewers are projected. A. Weir Gilkeson is Borough Surveyor.

Manchester, Va.—J. C. Robertson, W. S. Dashiell, F. Z. Caracristi and others are reported to have submitted a proposition to construct a sewerage system for the city.

Charleston, S. C.—The Council Committee on Tidal Sewers has reported in favor of City Engineer Barbot's plans, outlined in these columns Sept. 20, and recommends engaging one or more consulting engineers to examine the system.

Cordele, Ga.—It is reported that the town will soon vote on issuing bonds for a sewerage system. The mayor will give further information.

Dayton, O.—G. S. Pierson, M. Am. Soc. C. E., and Cady Staley have designed a sewerage system for this city. Bids for construction of the same were recently opened and will be found tabulated in another column.

Elkhart, Ind.—City Engineer Cook has been ordered to make surveys for 2 miles of sewers.

Winona, Minn.—Chester B. Davis, of Chicago, has been engaged to report on a sewerage system. J. B. Fellows is City Engineer.

Tyler, Tex.—The City Council desires some party to make an offer to construct and operate a sewerage system. The town is well located for a gravity system.

Paving.—Grading, curbing and macadamizing have been ordered at Louisville, Ky., and brick, asphalt or stone pavement at Columbus, O.

Toronto, Ont.—Asphalt paving costing $46,310 has been ordered on 2 streets, also a large amount of cedar block work.

Boston, Mass.—The Council has appropriated $121,000 for street extensions and improvements.

Buffalo, N. Y.—Assessment rolls for considerable 1st and 2d class Medina sandstone, Trinidad and German rock asphalt.

Newark, N. J.—The Common Council has authorized a large amount of trap block and some asphalt and granite pavement. Tilford will probably be given up.

Baltimore, Md.—The Highway Committee has recommended sheet asphalt, costing $18,000, and considerable Belgian block repaving.

St. Louis, Mo.—The Street Commissioners have submitted estimates for a large amount of work on over 50 streets.

St. Paul, Minn.—Grading at an estimated expense of $18,170 has been recently ordered.

Bonds.—*Columbus, O.*—The City Council has decided to issue $40,000 of bonds for constructing a trunk sewer.

ELECTRICAL.

Electric Light.—New plants are proposed in the following places: Hyattsville, Md., address J. H. Ralston; Burlington, N. C., address the Aurora Cotton Mills; Florence, S. C., address the Florence Improvement & Mfg. Co.; Newman, Ga.,; Union City, Tenn., address J. E. Beck; Gallatin, Tenn.; Comanche, Tex., address J. F. McCarthy; Dallas, Ore.

Herkimer, N. Y.—The town has voted to purchase a $10,000 electric light plant and bids are wanted at once.

Boston, Mass.—The Council Committee on Ordinances recently reported a bill authorizing the appointment by the mayor of an inspector of wires, at an annual salary of $3,500, who shall have charge of all wires and machinery and be empowered to enforce the laws regarding them.

Norwalk, Conn.—The Norwalk & South Norwalk Electric Light Co. has voted to expend $10,000 for enlarging its buildings, $25,000 for machinery and $25,000 for a new electrical plant.

Water Valley, Miss.—The city has voted to issue $10,000 of electric light and water-works bonds.

Alexandria, La.—It is stated that the city has contracted with the Thomson-Houston Electric Co., of Boston, Mass., for the erection of an electric light plant, and for the construction of water works.

Los Angeles, Cal.—The following bids on a 2-year street lighting contract were recently received: Westinghouse Co., $15 per month per 2,000 c. p., and $22.50 for 3,000 c. p. lights each. W. B. Cline, $12 for 2,000 and $18 for 3,000 c. p. lights. Rhodes & Kiese (Thomson-Houston system), $19 50 for 2,000 c. p. and $22 for 3,000 c. p. lights.

Albina, Ore.—The citizens of this progressive city are evidently bent on turning night into day. An exchange states that they propose placing a 20 c. p. incandescent street lamp on each second block at a monthly expense of $96.25.

A Large Motor Plant.—Two large cranes, operated by electricity, are building in the shops of Wm. Sellers & Co, for the Baldwin Locomotive Works. Each of these wil carry one 5 HP. Wenstrom and two 45 HP. Westinghouse motors, and can lift the heaviest class of locomotives. In addition to these 100-ton cranes, there will be 6 jib cranes driven by slow speed Wenstrom motors. The entire plant will represent between 500 and 600 HP. of dynamos and motors.

CONTRACTING.

New York City.—Recent bids for 2,460 sq. yds of trap block pavement were $1.89, $2.04 and $2.05 per sq. yd.

Troy, N. Y.—City Engineer C. L. Fuller, writes that 20,000 sq. yds. of granite paving were let recently at $3.40 per sq. yd. and 79 cts. for curbing; 5,450 sq. yds. at $3 05 and 7,450 sq. yds. at $3.24. The blocks must be from 8 to 12 ins. long, 7 to 8 ins. wide and 3½ to 4½ ins. thick, joints being filled with paving cement.

Syracuse, N. Y.—City Engineer H. C. Allen writes that the latest contracts for asphalt paving have been let at 29, 30 and 31 cts. per sq. ft.; for sandstone on concrete with asphalt joints, 41 cts. per sq. ft., macadam, grey limestone substructure and trap rock surfacing, 97 cts, and $1.04 per rq. yd. Sandstone curbing, 48 × 24 × 6 ins. in sand costs 60 cts. per. lin. ft.; 48 × 24 × 5 ins. in concrete costs the same.

Atlanta, Ga.—Warren & Parkhurst have a contract for a double-layer vitrified brick pavement on a sand and gravel foundation at $1.57½ per sq. yd.

Key West, Fla.—G. J. Baer, Kansas City, Mo., has received a contract for 25,000 sq. yds. of brick paving at $3.44, and 6 miles of curbing at 73 cts., with grading at $1.50 per cu. yd. A. F. Nims, Nebraska City, Neb., has a contract for 53,000 sq. yds. of brick paving at $2.69, and 2 miles of curbing at 79 cts. The paving brick, some 4,000,000, will be purchased in the vicinity of New York unless more favorable bids are received from elsewhere.

Cleveland, O.—The Warren-Scharf Asphalt Paving Co. recently laid about 7,000 sq. ft. of asphalt on two streets, the first pavement of the kind in the city. The company now has agencies in 19 cities.

St. Louis, Mo.—Stifel & Ruckert have receiven a $47,000 cedar-block paving contract.

Sewers.—*New York City.*—Recent bids on a large sewer were as follows:

Items.	Quant.	T. A. Smith, Price.	T. A. Smith, Am't.	F. Thileman, Jr. Price.	F. Thileman, Jr. Am't.
Lin. ft. brick sewer, egg-shaped, 4 1-6 × 3 1-6 ft.	960	$10	$9,600	$11.00	$10,560
Lin. ft. brick sewer, egg-shaped, 3⅝ × 2⅝ ft.	1,060	9	10,440	9.00	10,440
Lin. ft. brick sewer, egg-shaped, 3⅛ × 2⅛ ft.	600	8	4,800	7.00	4,200
Lin. ft. brick sewer, egg-shaped, 3 × 2⅛ ft.	3,260	6	18,360	6.50	19,890
Lin. ft. 18-in. pipe sewer	470	4	1,880	3.50	1,645
Lin. ft. 15-in. pipe sewer	2,950	3	10,325	2.85	8,408
Lin. ft. 12-in. pipe sewer	2,670	3	9,345	2.75	7,343
Spurs for house connections	1,310	50 cts.	655	.75	982
Manholes complete	105	$60	6,300	48.00	5,040
Receiving basins	27	150	4,050	148.00	3,996
Feet (B. M.) timber	10,000	22	220	25.00	250
Cu. yds, concrete in place	50	6	300	5.00	250
Cu. yds. broken stone	100	2	200	1.50	150
Cu. yds. dry rubble masonry	50	5	250	4.00	200
Cu. yds. rock excavation	17,000	4	68,000	3.70	62,900
Totals			$144,725		$136,224

Denver, Colo.—The bids for the Delgany trunk sewer were as follows: Riley & Co., $79,481; O'Brien & Co., $79,292; H. A. Armstrong & Co., $73,564.

Dredging.—*Savannah, Ga.*—Recently opened bids for dredging from 450,000 to 500,000 cu. yds. of earth in the Savannah River were as follows: P. Sanford Ross, 18 cts.; Savannah Dredging Co., 18¼ cts.; American Dredging Co., 19⅛ cts. per cu. yd.

Tunnel.—*St. Louis Mo.*—The Fruin-Bambrick Construction Co. has received a $187,800 contract for the inshore water tunnel, engine pit, etc., at Chain of Rocks.

Dam.—*Austin, Tex.*—The lowest bid for the Colorado River dam was $501,150, by B. Corrigan, Kansas City. The work involves 17,000 cu. yds. of dimension stone masonry, 70,000 cu. yds. rubble masonry, 75,000 cu. yds. earth and 55,000 cu. yds. rock excavation.

PROPOSALS OPEN.

Paving.—*Brooklyn, N. Y.*—Grading and paving with cobble stone and Belgian blocks. J. P. Adams, Oct. 30 and Nov. 3.

Pittsburg, Pa.—Grading and paving with either block or cobble stone or asphalt. E. M. Bigelow, Oct. 31.

Sewers.—*Cleveland, O.*—Timber-box sewer on piles. C. G. Force, Nov. 1.

Rails.—*Georgetown, Ky.*—The Georgetown Street Ry. wants prices on one mile of 20-lb. tram and same length of steel 20-lb. T rails.

Clifton Forge, Va.—The Clifton Forge Co. wants 25 or 30-lb. steel or iron rails for a 2-mile dummy line.

Electric Light Plant.—*Waynesboro, Va.*—Plant for 10 arc lights of 2,000 c. p., and a number of incandescent lamps.

Water Mains.—*Augusta, Ga.*—Furnishing 4,500 lin. ft. of 4-in. cast-iron pipe. Maj. J. W. Reilly, Nov. 13.

Breakwater.—*Cleveland, O.*—Constructing 450 lin. ft. of breakwater. Maj. L. C. Overman. Nov. 3.

Jetties.—*St. Augustine, Fla.*—Furnishing materials and constructing jetties at the mouth of the St. Johns River. Capt. W. M. Black. Nov. 15.

Steel.—*Jersey City, N. J.*—About 215 tons of mild steel for the Diamond Shoals Light House. Anderson & Barr, 240 Eleventh St.

Ship Channels.—*Baltimore, Md.*—Completing ship channel into Baltimore. Col. W. R. Craighill, U. S. Engineers' Office, Dec. 2.

Rock Excavation.—*Cleveland, O.*—Rock excavation and dredging in Ashtabula Harbor, O. Maj. L. C. Overman. Nov. 3.

Buffalo, N. Y.—2¼ and 2 ft. brick, and 15, 12 and 10-in. tile sewers. G. E. Mann. Oct. 27.

MANUFACTURING AND TECHNICAL.

The Hughes Steam Pump Co., of Cleveland, O., is now engaged in tripling its capacity for manufacturing steam pumps for water-works, etc., and has recently started machinery in their new machine shops. Work on their buildings was begun on May 1. All work in the machine shop is to be done on the ground floor. This building is 200 ft. long × 80 ft. wide. The new clearing shop is 60 ft. long × 40 ft. wide. A 10-ton traveling crane, 30 ft. wide, is to run the whole length of the machine shop. A considerable amount of new machinery will soon be put in operation. The company reports orders enough now on hand to run day and night all winter. Some large engines for marine service have recently been completed, and among other work they have recently completed pumps for the new water supply systems at Hudson, Mich., Hicksville, O., Murphysville, Ill., and Webb City and Cartersville, Mo. They are now erecting pumps for the water-works to be constructed at Goshen, Ind., Conneaut and Marysville, O., and Hudson, Mich.

Cars.—The Ohio Falls Car Works recently received a contract to build 500 fruit cars for the East Tennessee, Virginia & Georgia Ry. A new car company will probably be formed at Beaumont, Tex., under the name of the Beaumont Car Works. It is reported to be under the direction of the National Rolling Stock and Street Car Co of Boston, Mass.

Locomotives.—The Texas & Pacific Ry. has recently ordered 10 locomotives from the Baldwin Works. The Southern Pacific R. R. has ordered six passenger engines for use on the line between Houston and Lafayette. They will weigh 51 tons and have 18 × 24 in. cylinders.

The King & Iron Bridge & Mfg Co., Cleveland, O., will begin work on the addition to their plant of a new girder shop, 80 ft. wide × 150 ft. long, as soon as plans can be prepared. A large overhead traveling crane for this shop will soon be purchased. They are busy in all departments at present, and among their bridge contracts is the large bridge at Cincinnati, O., 3,000 ft. long, details of which we shall publish later; and a 4-span bridge at Buffalo, to carry the D., L. & M. tracks over the West Shore Ry.

The Yale & Towne Mfg. Co. announce the following changes in its officers: Schuyler Merritt, since 1878 Secretary, and since 1884 the General Manager, resigns the latter position, but retains that of Sec'y. W. F. Donovan, since 1880 the Manager of the Co.'s Chicago House, and Manager of its Western business, is appointed to the position of General Manager. Geo. S. Redfield, recently Manager of the Tubular Axle Dep't of the National Tube Works Co., of Boston and McKeesport, has been appointed to the position of Manager of the Department of Locks and Hardware at Stamford. B. H. Warren, recently Superintendent of the Works of the Hancock Inspirator Co., Boston, has been appointed to the position of Manager of the Department of Cranes and Pulley Blocks, Hoists, etc., at Stamford. H. H. Suplee, recently editor of *Mechanics*, and also consulting engineer in Philadelphia has been appointed to the position of Editing Manager, at Stamford. He will have entire charge of the presentation of the products of the company before the public, including all editorial work and advertising. W. H. Bryan, recently Sec'y of the Heisler Electric Light Co., St. Louis, Mo., is appointed to the position of Manager of the Chicago house. F. H. Taylor, formerly President of the Belmont Iron Co., Philadelphia, was appointed in February last to the position of Manager of the Philadelphia house, vice J. T. Boyd, resigned.

I. H. Pratt, Engineer and Contractor, Cleveland, O., has contracted with the Taylor & Boggis Foundry Co. to furnish them with a 250 HP. Corliss engine. Also to furnish a 75 HP. Corliss engine to the Dangler Vapor Stove Mfg. Co., and a pump and boiler for the water station of the Akron & Chicago Junction R. R., at Akron, O.

New Companies.—Ajax Rustless Teredo-Proof Pile Armor Co., San Francisco, Cal., capital stock, $1,000,000; incorporators, D. S. Dorn, R. J. Davis, R. H. McDonald. Kankakee, Ill., Street Ry., capital stock, $25,000; incorporators, W. A. McGillis, G. R. Letourneau, P. Mellaleson. Cahener Railway Power Transmission & Brake Co., Chicago, Ill.; capital stock, $300,000; incorporators, T. J. Thorp, T. Bennett, W. H. Herrick. Osborn Construction Co., Chicago, Ill.; capital stock, $100,000; incorporators, P. J. Norton, T. Burkhard, J. Lattin.

Metal Market Prices.—*Rails*—New York: $30; $26 for old iron rails. Chicago: $32 to $32.50; old rails, $26.50 to $27 for iron, $22 for steel. Pittsburg: $30 to $31; old rails, $27.50 to $28 for iron; $19.50 to $20.50 for steel.

Foundry Pig-iron.—Chicago: $15 to $17. Pittsburg: $15.50 to $17.25. New York: $16 to $18.

Track Materials.—New York: steel angle bars, $1.80 to $1.95; spikes, $2.20 to $2.25; track bolts, 2.95 to 3.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.2 cts.; track bolts, 2.9 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 to 2.3 cts. for steel, and 2.1 to 2.2 cts. for iron; spikes, 2.3 to 2.35 cts; iron track bolts $3.10 to $3.15 with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—Chicago, 5.3 to 5.35 cts. New York, 5.25 to 5.75 cts.

Structural Material.—Pittsburg: angles, 2.3 cts.; tees, 2.85 cts.; beams and channels, 3.1 cts.; sheared steel bridge plates, 2.65 to 2.7 cts.; universal mill plates, 2.35 cts.; refined bars, 1.9 to 1.95 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.1 to 3.2 cts. for flange; 2.9 cts. for shell, 2.5 to 2.55 cts. for tank. New York: beams, 3.10 cts.; plates, 2.25 cts.; angles, 2.1 to 2.25 cts.; tees, 2.6 to 2.7 cts.; channels, 3.1 cts. Chicago: angle, 2.35 to 2.4 cts.; tees, 2.9 to 3.0 cts. beams, 3.2 cts.; universal plates, 2.45 to 2.55 cts.; sheared plates, iron, 2.5 to 2.6 cts.; steel, 2.6 to 2.7 cts.

Price per lineal foot.

Bidder's Name.	Pipe laid. 18 in.	15 in.	12 in.	10 in.	8 in.	6 in.	5 in.	Drain tile laid. 6 in.	5 in.	4 in.	3 in.	Brick Sewer. 42 in.	40 in.	36 in.	30 in.	Excavation. -6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	Re-paving.	Prices each. Manhole.	Lamp holes.	Flush Tanks.	Iron pipe, price in tons.	Embankment, cu yds.	Clay puddle, cu. yds.	Total Bids.
Estimated quantities	5600	100	2800	7400	35000	1000	5000	5000	1000	1000	2000	1600	25	3300	2100	12000	14000	22000	10000	3000	7000	1000	100	1500	180	200	60	110	3000	100	
F. Whitley	1.60	1.25	1.10	1.00	.65	.55	.55	.04	.03	.02	.02	3.90	3.90	3.80	4.00	.10	.06	.06	.06	.20	.20	.20	.20	.25	20.	3.00	25.	60.00	.60	1.50	$92,988
D. F. Minchan	.77	.52	.36	.30	.23	.13	.11	.08	.07	.06	.06	4 00	4.00	4.00	3.50	.23	.37	.39	.60	.90	.95	1.08	1.30	.45	34.	5.00	21.	55.00	.40	1.25	88,782
J. Munger	.60	.50	.33	.26	.21	.14	.12	.05	.04	.03	.023	2.39	2.34	2 05	1.70	.20	.35	.40	.60	1.10	1.20	2.00	2.50	.12	25.	3.00	25.	38-25	.30	2.00	71,069
R. J. Paul	.67	.53	.43	.37	.24	.17	.14	.12	.095	.09	.09	2.90	2.90	2.55	2 20	.24	.40	.44	.59	.85	1.09	1.24	2.25	.70	34.	9.00	85.	57.00	.67	1.40	88,295
B. Ritty	.76	.52	.40	.33	.23	.18	.16	.14	.12	.10	08	2.78	2.41	2.25	2.05	.16	.20	.26	.37	.45	.63	.96	1.04	.15	25.10	9.35	23.	50 00	.20	.50	66,175

Van Wert, O., Water-Works.

Sealed Proposals will be received until noon of Thursday, Oct. 30, 1890, by the Board of Water-Works of Van Wert, O., for the following items for the Van Wert Water-Works:

One thousand six hundred and fourteen (1,614) tons of cast iron water pipe, ranging from four (4) to sixteen (16) ins. diameter.

Eighty-two thousand three hundred and twenty-five (82,325) lbs. of special castings for above pipe.

Eighty-one (81) six (6) in. double nozzle fire hydrants and sixty-six (66) four (4) in. double nozzle fire hydrants.

One hundred and twelve (112) stop valves, from four (4) to sixteen (16) ins. diameter, and one hundred and twelve (112) stop boxes for above valves.

Laying of above pipe and setting of above special castings, fire hydrants, stop valves and stop boxes.

One brick pumping station and one brick chimney.

Trenching and all labor and materials for the connecting together of a system of drilled six (6) in. wells.

Two (2) compound condensing duplex direct-acting pumping engines, each of one million five hundred thousand (1,500,000) galls. daily capacity, together with two (2) return tubular boilers and all appurtenances necessary to complete said machinery.

One (1) earthen reservoir of three million 3,000,000) galls. nominal capacity.

Proposals must be made on the blank forms furnished by the Board of Water-Works, and all legal formalities must be complied with to secure consideration of the proposals.

The preliminary bonds and date of furnishing materials and completion of work must be filed to constitute a formal proposal.

Plans for above work may be examined and blank form of proposal and specifications can be obtained at the office of the Board of Water-Works, Van Wert, O., or the office of the Engineer, rooms 21-22, Glenn Building, Cincinnati, O.

The proposals must be sealed and addressed to the Board of Water Works, Van Wert, O., and be indorsed with the name of the person, firm or corporation which makes the tender.

And be accompanied with a certified check payable to the order of the Board of Water-Works, as follows:

Water pipe and special castings	$500
Fire hydrants	300
Stop valves	200
Pipe laying	400
Pumping station and chimney	300
Connection of drilled wells	300
Pumping machinery	500
Reservoir	300

The Board of Water-Works reserve the right to reject any or all proposals.

O. A. BALYEAT,
A. B. GLEASON,
W. C. BROOKS,
H. BUTLER,
W. B. JONES,
} Board of Water-Works.

JOHN W. HILL, Consulting and Constructing Engineer, Cincinnati, O.

VAN WERT, O., Oct. 3, 1890. 42-2t

Galt Water-Works.

NOTICE TO CONTRACTORS.

Sealed tenders will be received by I. G. Dykes, Town Clerk of Galt, Ontario, Canada, until 12 o'clock noon on Monday, the 17th day of November, A. D. 1890, to be endorsed "Tender for Water-Works."

Tender A.—For the construction of a complete system of Water-Works for said town.

Tender B.—For the construction and collecting galleries, conduit, pump well with accessories.

Tender C.—For the construction of all works not included in Tender B.

For blank forms of tender, instructions to bidders and other information apply to I. G. Dykes, Town Clerk.

Plans and specifications, forms of contract, etc., may be seen on and after Oct. 13, 1890, at the office of the Town Clerk and at the office of the Chief Engineer, 103 Bay St., Toronto

I. G. DYKES, Town Clerk. WILLIS CHIPMAN, Chief Engineer.

Galt, October, 1890. 42-2t

AT A SACRIFICE.

A complete cotton factory with latest improved machinery, with thirty acres of beautifully located land, in one of the most flourishing young cities in Southwest Texas for Sale. Land alone worth half the money. Write for particulars to

RANNEY & MONTGOMERY, Yoakum, Tex.

42-4t

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - ALA.

Especially adapted for the Elevation of Clear, Gritty, Thick, or Acidulous Liquids, Quickly, Cheaply and Efficiently.

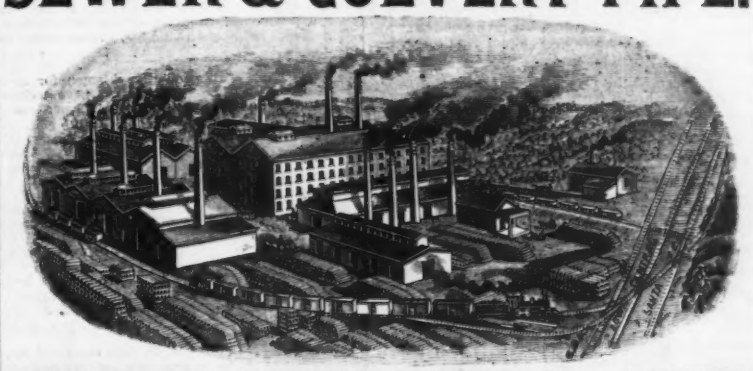
PATENTED U. S. AND CANADA.

THE NEW PULSOMETER STEAM PUMP.

without Engine, Machinery, Oil, Expensive Power, Skilled Labor, or Material Wear. Send for Illustrated Catalogue.

PULSOMETER STEAM PUMP CO., 120 Liberty St., New York.

DOUBLE STRENGTH SEWER & CULVERT PIPE.



MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

Ore Dock.

OFFICE OF IRON RANGE & HURON BAY R. R. CO., ARVON, Mich., Oct. 8, 1890.

Proposals will be received at this office for the furnishing of the labor and material for the construction of an Ore Dock for the Iron Range & Huron Bay R. R. Co. on Huron Bay, Lake Superior, Baraga county, Mich., until 12 o'clock noon, Nov. 15, 1890.

There will be about 2,000,000 ft. B. M. of timber and 3,000 piles.

Plans and specifications can be seen at this office.

The right to reject any or all bids is reserved.

MILO DAVIS, Chief Engineer, Arvon, Baraga Co., Mich.

42-4t

Willimansett Bridge Masonry.

TO CONTRACTORS.

Sealed proposals will be received by the Commissioners of Hampden County, Mass., until 10 A. M. of Wednesday, November 19, 1890, for the masonry and foundations of a bridge over the Connecticut River at Willimansett, Mass.

All bids must be in accordance with plans and specifications, which will be mailed to contractors, upon application to Edward S. Shaw, consulting engineer, 146 Franklin street, Boston, and which may be examined at the office of the County Clerk, Springfield.

The party to whom the contract may be awarded will be required to furnish a bond for a sum of not less than one-quarter nor more than one-half of the amount of the contract, with sureties satisfactory to the County Commissioners.

The Commissioners reserve the right to reject any or all proposals.

LEONARD CLARK,
HARVEY D. BAGG,
LEWIS F. ROOT.
} Board of Commissioners, of Hampden County.

SPRINGFIELD, Mass., Oct. 18, 1890. 43-1t

INSTRUMENTS FOR SALE.

Fine set transit and level—Blunt, maker—in perfect order. Also complete assay laboratory for sale very low. Address F. C. HAND, Abbeville, Ga. 43-1t

Artesian Well.

OFFICE OF THE CITY OF CHARLESTON WATER-WORKS CO., GEORGE ST., CHARLESTON, S. C., Oct. 13, 1890.

Proposals are invited for sinking an artesian well in the city of Charleston, S. C.

The depth of the well to be not less than 2,000 ft., with a minimum diameter of 6 in. at the maximum depth.

All proposals must be forwarded by the first day of December next.

Full particulars will be furnished on application to the undersigned.

ZIMMERMAN DAVIS, Secretary and Treasurer.

42-7t

Notice to Sewer Contractors.

Sealed proposals will be received at the office of the Recorder of Albuquerque, New Mexico, until two o'clock P. M., on the firs day of November, 1890, for constructing sewers in the town of Albuquerque, Bernalillo Co. New Mexico.

Forms of proposals, copies of specifications and instructions to contractors may be obtained of the Recorder or of the Engineer, and the plans and profiles may be seen at the office of either of the above named parties.

Each bid must be accompanied by a deposit of one thousand dollars ($1,000) as a guarantee of the good faith of the bidder.

The Board of Trustees reserve the right to reject any or all bids.

Address HENRY LOCKHART, Recorder, Albuquerque, N. M.

W. KIERSTED, Engineer, 620 Keith & Perry Building, Kansas City, Mo.

40-4t.

To Dredging Contractors.

Proposals for increasing the depth of water at our wharf from 15 to 18 ft. at mean high water. Face of wharf, 207 ft. Width of channel to be dug, 35 ft. Bottom rocky and gravelly. Blue prints indicating depth of water and character of bottom, taken every two feet, will be furnished on application. Communicate with

WM. C. ATWATER & CO., Fall River, Mass.

43-1t

Proposals for Water-Works Material for Remodeling, Enlarging and Extending the San Angelo Water-Works.

SAN ANGELO, Texas, Oct. 10, 1890.

Sealed proposals will be received at this office until 12 M. Monday, Nov. 10 proximo, to furnish and deliver at R. R. Depot, this city, 400 (four hundred) lineal feet 12-in., 5,800 (five thousand eight hundred) lineal feet 10-in., 5,100 (five thousand one hundred) lineal feet 8-in., 3,200 (three thousand two hundred) lineal feet 6-in., 12,400 (twelve thousand four hundred) lineal feet 4-in., standard weight and size, cast iron water pipe for street mains, coated with Smith's patent enamel varnish coal tar, and to stand a pressure of 300 lbs. to the square inch at foundry.

20,000 (twenty thousand pounds) of specia castings. (Above quantities of pipe and specials are approximate.)

14 (fourteen) valves for the street mains, ranging from 12 to 4-in.

25 (twenty-five) 2 hose-way star dard size 2½-in. tip, 4-in. inlet fire hydrants, 3 ft. from pavement line to inlet.

16,000 (sixteen thousand) lbs. of soft lead.

1,100 (eleven hundred) " " yarn.

One compound duplex non-condensing steam pump; 12 and 18-in. cylinders by 10½ water cylinders, 18-in. length of stroke, so arranged as to admit live steam direct from boiler into the 18-in. cylinders for fire pressure. To be built sufficiently strong to work for direct fire pressure service to 135 lbs. water pressure.

One water-power pump; 1,000,000 galls. daily (24 hours) capacity, and capable of pumping for fire pressure against 135 lbs. water pressure.

Suction and discharge openings of above pumps to be 12 and 10 ins respectively, and fitted for the standard cast iron pipe.

One 70 HP. automatic cut off steam engine. (Bids for the pumps not to be based upon *both* pumps being take .)

One steel return tubular boiler, 52-in. diameter by 14 ft. long, 56 3-in. tubes, with all fixtures complete.

Separate bids to furnish "the pipe and specials," "the valves and hydrants," "the lead and yarn," "the pumps," "the engine and boiler," will be considered. Prices to include freight charges to San Angelo. Proposals to be addressed to the undersigned, and envelopes marked "Proposals for Water-Works Material."

J. V. MILLSPAUGH, Pres. San Angelo Water Works Co.

42-2t

Notice to Contractors.

Sealed proposals will be received at the office of the Clerk to Town Council, until noon on THURSDAY, NOV. 20, for the construction of a two-million gallon reservoir, and furnish, lay and connect about nine thousand feet of ten and twelve-inch cast iron pipe, with the special castings, etc. Separate proposals received for the construction of the reservoir and the pipe and laying, or both together.

All proposals must be signed by the bidder and accompanied by a certified check for $500, made payable to Borough Treasurer of Chambersburg, Pa., as a guarantee that contractor will, within five days after notification of award, execute and contract. Checks of rejected bidders returned.

The right to reject any and all bids reserved by Water Committee.

Plans and specification can be seen at the Council Chamber, Chambersburg, Pa., and at the office of John Birkinbine, No. 25 North Juniper St., Philadelphia, Pa.

D. B. KIRBY, Clerk.

CHAMBERSBURG, Pa., Oct. 20, 1890. 43-2t

Iron Swing Bridge

SHEBOYGAN, Wis., Oct. 17, 1890.

The Board of Public Works invites plans and specifications for an iron swing bridge over the Sheboygan River at Eighth street, to replace the one now in use.

Width of roadway	20 feet in clear
Two foot-walks, each	7 " " "
Space between center pier and abutments on either side	65 " " "
Height above high water	13 " " "
Depth of river at ordinary stage	17 " " "

Abutments and center pier, stone on pile foundations. The right is reserved to reject any or all plans. For further particulars address. C. U. BOLEY, City Engineer, as above.

43-1t

(For other Proposals See Pages XIV, XXII and XXVII.)